PART 20 STANDARDS FOR PROTECTION AGAINST RADIATION

Authority: §§ 53, 63, 65, 81, 103, 104, 161, 182, 186, 68 Stat. 930, 933, 935, 936, 937, 948, 953, 955, as amended, § 1701, 106 Stat. 2951, 2952, 2953 (42 U.S.C. 2073, 2093, 2095, 2111, 2133, 2134, 2201, 2232, 2236, 2282, 2297f); § 201, as amended, 1244, 1246 (42 U.S.C. 5841, 5842, 5846).

Subpart A—General Provisions

§ 20.1001 Purpose

(a) The regulations in this part establish standards for protection against ionizing radiation resulting from activities conducted under licenses issued by the Nuclear Regulation Commission. These regulations are issued under the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974, as amended.

(b) It is the purpose of the regulations in this part to control the receipt, possession, use, transfer, and disposal of licensed material by any licensee in such a manner that the total dose to an individual (including exposures to licensed and unlicensed radioactive material and from radiation sources other than background radiation) does not exceed the standards for protection against radiation prescribed in the regulations in this part. However, nothing in this part shall be construed as limiting actions that may be necessary to protect health and safety.

§ 20.1002 Scope.

The regulations in this part apply to persons licensed by the Commission to receive, possess, use, transfer, or dispose of byproduct, source, or special nuclear material or to operate a production or utilization facility under Parts 30 through 36, 39, 40, 50, 60, 61, 70, or 72 of this chapter, and in accordance with 10 CFR 76.60 to persons required to obtain a certificate of compliance or an approved compliance plan under part 76 of this chapter. The limits in this part do not apply to doses due to background radiation, due to any medical administration the individual has received, or due to voluntary participation in medical research programs.

§ 20.1003 Definitions.

As used in this part:

Absorbed dose means the energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the rad and the gray (Gy).

Act means the Atomic Energy Act of 1954 (42 U.S.C. 2011 *et seq*.), as amended.

Activity is the rate of disintegration (transformation) or decay of radioactive material. The units of activity are the curie (Ci) and the becquerel (Bq).

Adult means an individual 18 or more years of age.

Airborne radioactive material means radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors, or gases.

Airborne radioactivity area means a room enclosure, or area in which airborne radioactive materials, composed wholly or partly of licensed material, exist in concentrations—

(1) In excess of the derived air concentrations (DAC) specified in appendix B to §§ 20.1001-20.2401, or

(2) To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

ALARA (acronym for "as low as is reasonably achievable") means making every reasonable effort to maintain exposures to radiation as far below the dose limits in this part as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations and in relation to utilization of nuclear energy and licensed materials in the public interest.

Annual limit of intake (ALI) means the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by reference man that would result in a committed effective dose equivalent of 5 rems (0.05 Sv) or a committed dose equivalent of 50 rems (0.5 Sv) to any organ or tissue. (ALI values for intake by ingestion and by inhalation of selected radionuclides are given in Table 1, Columns 1 and 2 of Appendix B to §§ 20.1001-2401).

Background radiation means radiation from cosmic sources; naturally occurring radioactive material, including radon (except as a decay product of source or special nuclear material); and global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under the control of the licensee. "Background radiation" does not include radiation from source, byproduct, or special nuclear materials regulated by the Commission.

Bioassay (radiobioassay) means the determination of kinds, quantities or concentrations, and, in some cases, the locations of radioactive material in the human body, whether by direct measurement (in vivo counting) or by analysis and evaluation of materials excreted or removed from the human body.

Byproduct material means—

(1) Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident to the process of producing or utilizing special nuclear material; and

(2) The tailings or wastes produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface wastes resulting from uranium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute "byproduct material" within this definition.

Class (or *lung class* or *inhalation class*) means a classification scheme for inhaled material according to its rate of clearance from the pulmonary region of the lung. Materials are classified as D, W, or Y which applies to a range of clearance half-times: for Class D (Days) of less than 10 days, for Class W (Weeks) from 10 to 100 days, and for Class Y (Years) greater than 100 days.

Collective dose is the sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation.

Commission means the Nuclear Regulatory Commission or its duly authorized representatives.

Committed dose equivalent ($H_{T,50}$) means the dose equivalent to organs or tissue of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

Committed effective dose equivalent ($H_{E,50}$) is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues ($H_{E,50} = w_T H_{T,50}$).

Constraint (*dose constraint*) means a value above which specified licensee actions are required.

Controlled area means an area, outside of a restricted area but inside the site boundary, access to which is limited by the licensee for any reason.

Critical Group means the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.

Declared pregnant woman means a woman who has voluntarily informed her employer, in writing, of her pregnancy and the estimated date of conception.

Decommission means to remove a facility or site safely from service and reduce residual radioactivity to a level that permits–

(1) Release of the property for unrestricted use and termination of the license; or

(2) Release of the property under restricted conditions and termination of the license.

Deep dose equivalent (H_d), which applies to the external whole-body exposure, is the dose equivalent at a tissue depth of 1 centimeter (1000 mg/cm^2).

Department means the Department of Energy established by the Department of Energy Organization Act (Pub. L. 95-91, 91 Stat. 565, 42, U.S.C. 7101 et seq.) to the extent that the

Department, or its duly authorized representatives, exercises functions formerly vested in the U.S. Atomic Energy Commission, its Chairman, members, officers, and components and transferred to the U.S. Energy Research and Development Administration and to the Administrator thereof pursuant to sections 104(c), (c), and (d) of the Energy Reorganization Act of 1974 (Pub. L. 93-438, 88 Stat. 1233 at 1237, 42 U.S.C. 5814) and retransferred to the Secretary of Energy pursuant to section 301(a) of the Department of Energy Organization Act (Pub. L. 95-91, 91 Stat. 565 at 577-578, 42 U.S.C. 7151).

Derived air concentration (DAC) means the concentration of a given radionuclide in air which, if breathed by reference man for a working year of 2,000 hours under conditions of light work (inhalation rate 1.2 cubic meters of air per hour), results in an inhalation of one ALI. (DAC values are given in Table 1, Column 3 of Appendix B to §§ 20.1001-20-2401.

Derived air concentration-hour (DAC-hour) is the product of the concentration of radioactive material in air (expressed as a fraction or multiple of the derived air concentration for each radionuclide) and the time of exposure to that radionuclide, in hours. A licensee may take 2,000 DAC-hours to represent one ALI, equivalent to a committed effective dose equivalent of 5 rems (0.05 Sv).

Distinguishable from background means that the detectable concentration of a radionuclide is statistically different from the background concentration of that radionuclide in the vicinity of the site or, in the case of structures, in similar materials using adequate measurement technology, survey, and statistical techniques.

Dose or *radiation dose* is a generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or total effective dose equivalent, as defined in other paragraphs of this section.

Dose equivalent (H_T) means the product of absorbed dose in tissue, quality factor and all other necessary modifying factors at the location of interest in tissue. The units of dose equivalent are the rem and sievert (Sv).

Dosimetry processor means an individual or organization that processes and evaluates individual monitoring equipment in order to determine the radiation dose delivered to the equipment.

Effective dose equivalent (H_E) is the sum of the products of the dose equivalent (H_T) to the organ or tissue (T) and the weighting factors (w_T) applicable to each of the body organs or tissues which are irradiated ($H_E = \sum_T w_T H_T$).

Embryo/fetus means the developing organism from conception until the time of birth.

Entrance or access point means any location through which an individual could gain access to radiation areas or to radioactive materials. this includes entry or exit portals of sufficient size to permit human entry, irrespective of their intended use.

Exposure means being exposed to ionizing radiation or to radioactive material.

External dose means that portion of the dose equivalent received from radiation sources outside of the body.

Extremity means hand, elbow, arm below the elbow, foot, knee, or leg below the knee.

Eye dose equivalent applies to the external exposure of the lens of the eye and is taken as the dose equivalent at a tissue depth of 0.3 centimeter (300 mg/cm^2).

Generally applicable environmental radiation standards means standards issued by the Environmental Protection Agency (EPA) under the authority of the Atomic Energy Act of 1954, as amended, that impose limits on radiation exposures or level, or concentrations or quantities of radioactive material, in the general environment outside the boundaries of locations under the control of persons possessing or using radioactive material.

Government agency means any executive department, commission, independent establishment, corporation wholly or partly owned by the United States of America which is an instrumentality of the United States, or any board, bureau, division, service, office, officer, authority, administration, or other establishment in the executive branch of the Government.

Gray (See § 20.1004).

High radiation area means an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface which the radiation penetrates.

Individual means any human being.

Individual monitoring means—

(1) The assessment of dose equivalent by the use of devices designed to be worn by an individual;

(2) the assessment of effective dose equivalent by bioassay (see *Bioassay*) or by determination of the time-weighted air concentrations to which an individual has been exposed, *i.e.*, DAC-hours; or

(3) the assessment of dose equivalent by the use of survey data.

Individual monitoring devices (*individual monitoring equipment*) means devices designed to be worn by a single individual for the assessment of dose equivalent such as film badges, thermoluminescent dosimeters (TLDs), pocket ionization chambers, and person (“lapel”) air sampling devices.

Internal dose means that portion of the dose equivalent received from radioactive material taken into the body.

License means a license issued under the regulations in parts 30 through 36, 39, 40, 50, 60, 61, 70, or 72 of this chapter.

Licensed material means source material, special nuclear material, or byproduct material received, possessed, used, or transferred under a general or specific license issued by the Commission.

Licensee means the holder of a license.

Limits (dose limits) means the permissible upper bounds of radiation doses.

Lost or missing licensed material means any licensed material whose location is unknown. It includes material which has been shipped but has not reached its destination and whose location cannot be readily traced in the transportation system.

Member of the public means any individual except when that individual is receiving an occupational dose.

Minor means an individual less than 18 years of age.

Monitoring (radiation monitoring, radiation protection monitoring) means the measurement of radiation levels, amounts or concentrations of radionuclides, or surface area concentrations of radionuclide, and the use of the results of these measurements to evaluate potential exposures and doses.

Nonstochastic effect means health effects, the severity of which varies with the dose and for which a threshold is believed to exist. Radiation-induced cataract formation is an example of a nonstochastic effect (also called a deterministic effect).

NRC means the Nuclear Regulatory Commission or its duly authorized representatives.

Occupational dose means the dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to radiation or to radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee or other person. Occupational dose does not include dose received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with § 35.75, from voluntary participation in medical research programs, or as a member of the public.

Person means—

(1) Any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission or the Department of Energy (except that the Department shall be considered a person within the meaning of the regulations in 10 CFR Chapter I to extent that its facilities and activities are subject to the licensing and related regulatory authority of the Commission under section 202 of the Energy Reorganization Act of 1974 (88 Stat. 1244)), any State or any political subdivision of or any political entity within a State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and

(2) any legal successor, representative, agent, or agency of the foregoing.

Planned special exposure means an infrequent exposure to radiation, separate from and in addition to the annual dose limits.

Public dose means the dose received by a member of the public from exposure to radiation or radioactive material released by a licensee, or to any other source of radiation under the control of a licensee. Public dose does not include occupational dose or doses received from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with § 35.75, or from voluntary participation in medical research programs.

Quality factor (*Q*) means the modifying factor (listed in tables 1004(b).1 and 1004(b).2 of § 20.1004) that is used to derive dose equivalent from absorbed dose.

Quarter means a period of time equal to one-fourth of the year observed by the licensee (approximately 13 consecutive weeks), providing that the beginning of the first quarter in a year coincides with the starting date of the year and that no day is omitted or duplicated in consecutive quarters.

Rad (See § 20.1004).

Radiation (ionizing radiation) means alpha particles, beta particles, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Radiation, as used in this part, does not include non-ionizing radiation, such as sound, radio, or microwaves, or visible, infrared, or ultraviolet light.

Radiation area means an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface which the radiation penetrates.

Reference man means a hypothetical aggregation of human physical and physiological characteristics arrived at by international consensus. These characteristics may be used by researchers and public health workers to standardize results of experiments and to relate biological insult to a common base.

Rem (See § 20.1004).

Residual radioactivity means radioactivity in structures, materials, soils, groundwater, and other media at a site resulting from activities under the licensee's control. This includes radioactivity from all licensed and unlicensed sources used by the licensee, but excludes background radiation. It also includes radioactive materials remaining at the site as a result of routine or accidental releases of radioactive material at the site and previous burials at the site, even if those burials were made in accordance with the provisions of 10 CFR part 20.

Respiratory protection device means an apparatus, such as a respirator, used to reduce the individual's intake of airborne radioactive materials.

Restricted area means an area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

Sanitary sewerage means a system of public sewers for carrying off waste water and refuse, but excluding sewage treatment facilities, septic tanks, and leach fields owned or operated by the licensee.

Shallow dose equivalent (H_S) applies to the external exposure of the skin or an extremity and is taken as the dose equivalent at a tissue depth of 0.007 centimeter (7 mg/cm^2) averaged over an area 1 square centimeter.

Sievert (see § 20.1004).

Site boundary means that line beyond which the land or property is not owned, leased, or otherwise controlled by the licensee.

Source material means—

(1) Uranium or thorium, or any combination of uranium and thorium in any physical or chemical form; or

(2) Ores which contain, by weight, one-twentieth of one percent (0.05 percent), or more, or uranium, thorium, or any combination of uranium and thorium. Source material does not include special nuclear material.

Special nuclear material means—

(1) Plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235, and any other material that the Commission, pursuant to the provisions of section 51 of the Act, determines to be special nuclear material, but does not include source material; or

(2) Any material artificially enriched by any of the foregoing but does not include source material.

Stochastic effects means health effects which occur randomly and for which the probability of the effect, occurring, rather than its severity, is assumed to be a linear function of dose without threshold. Hereditary effects and cancer incidence are examples of stochastic effects.

Survey means an evaluation of the radiological conditions incident to the production, use, release, disposal, or presence of radioactive materials or other sources of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

Total Effective Dose Equivalent (TEDE) means the sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

Unrestricted area means an area, access to which is neither limited nor controlled by the licensee.

Uranium fuel cycle means the operations of milling of uranium ore, chemical conversion of uranium, isotopic enrichment of uranium, fabrication of uranium fuel, generations of electricity by a light-water-cooled nuclear power plant using uranium fuel, and reprocessing of spent uranium fuel, to the extent that these activities directly support the production of electrical power for public use. Uranium fuel cycle does not include mining operations, operation at waste disposal sites, transportation of radioactive material in support of these operations, and the reuse of recovered non-uranium special nuclear and byproduct materials from the cycle.

Very high radiation area means an area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in 1 hour at 1 meter from a radiation source or from any surface which the radiation penetrates.

(**NOTE:** At very high doses received at high dose rates, units of absorbed dose (*e.g.*, rads and grays) are appropriate, rather than units of dose equivalent (*e.g.*, rems and sieverts).)

Week means 7 consecutive days starting on Sunday.

Weighting factor w_T, for an organ or tissue (T) is the proportion of the risk of stochastic effects resulting from irradiation of that organ or tissue to the total risk of stochastic effects when

the whole body is irradiated uniformly. For calculating the effective dose equivalent, the values of w_T are:

ORGAN DOSE WEIGHTING FACTORS

Organ or tissue	w_T
Gonads	0.25
Breast	0.15
Red bone marrow	0.12
Lung	0.12
Thyroid	0.03
Bone surfaces	0.03
Remainder	[1]0.30
Whole Body	[2]1.00

Whole body means, for purposes of external exposure, head, trunk (including male gonads), arms above the elbow, or legs above the knee.

Working level (WL) is any combination of short-lived radon daughters (for radon-222: polonium-218, lead-214, bismuth-214, and polonium-214; and for radon-220: polonium-216, lead-212, bismuth-212, and polonium-212) in 1 liter of air that will result in the ultimate emission 1.3×10^5 MeV of potential alpha particle energy.

Working level month (WLM) means an exposure of 1 working level for 170 hours (2,000 working hours per year/12 months per year = approximately 170 hours per month).

Year means the period of time beginning in January used to determine compliance with the provisions of this part. The licensee may change the starting date of the year used to determine compliance by the licensee provided that the change is made at the beginning of the year and that no day is omitted or duplicated in consecutive years.

§ 20.1004 Units of radiation dose.

(a) Definitions. As used in this part, the units of radiation dose are:

Gray (Gy) is the SI unit of absorbed dose. One gray is equal to an absorbed dose 1 joule/kilogram (100 rads).

Rad is the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs/gram or 0.01 joule/kilogram (0.01 gray).

Rem is the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (1 rem = 0.01 sievert).

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[1]0.30 results from 0.06 for each 5 “remainder” organs (excluding the skin and the lens of the eye) that receive the highest doses.

[2]For the purpose of weighting the external whole body dose (for adding it to the internal dose), a single weighting factor, $w_T = 1.0$, has been specified. The use of other weighting factors for external exposure will be approved on a case-by-case basis until such time specific guidance is issued.

Sievert is the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv = 100 rems).

(b) As used in this part, the quality factors for converting absorbed dose to dose equivalent are shown in table 1004(b).1.

TABLE 1004(b).1—QUALITY FACTORS AND ABSORBED DOSE EQUIVALENCIES

Type of radiation	Quality factor (*Q*)	Absorbed dose equal to a unit dose equivalent[3]
X-, gamma, beta radiation	1	1
Alpha particles, multiple-charged particles, fission fragments and heavy particles of unknown charge	20	0.05
Neutrons of unknown energy	10	0.1
High-energy protons	10	0.1

(c) If it is more convenient to measure the neutron fluence rate than to determine the neutron dose equivalent rate in rems per hour or sieverts per hour, as provided in paragraph (b) of this section, 1 rem (0.01 Sv) of neutron radiation of unknown energies, may, for purposes of the regulations in this part, be assumed to result from a total fluence of 25 million neutrons per square centimeter incident upon the body. If sufficient information exists to estimate the approximate energy distribution of the neutrons, the licensee may use the fluence rate per unit dose equivalent or the appropriate *Q* value from table 1004(b).2 to convert a measured tissue dose in rads to dose equivalent in rems.

[3]Absorbed dose in rad equal to 1 rem or the absorbed dose in gray equal to 1 sievert.

TABLE 1004(b).2—MEAN QUALITY FACTORS, *Q*, AND FLUENCE PER UNIT DOSE EQUIVALENT FOR MONOENERGETIC NEUTRONS

	Neutron energy (MeV)	Quality factor[4] (*Q*)	Fluence per unit dose equivalent[5] (neutrons cm^{-2} rem^{-1})
(thermal)	2.5×10^{-8}	2	980×10^{6}
	1×10^{-7}	2	980×10^{6}
	1×10^{-6}	2	810×10^{6}
	1×10^{-5}	2	810×10^{6}
	1×10^{-4}	2	840×10^{6}
	1×10^{-3}	2	980×10^{6}
	1×10^{-2}	2.5	1010×10^{6}
	1×10^{-1}	7.5	170×10^{6}
	5×10^{-1}	11	39×10^{6}
	1	11	27×10^{6}
	2.5	9	29×10^{6}
	5	8	23×10^{6}
	7	7	24×10^{6}
	10	6.5	24×10^{6}
	14	7.5	17×10^{6}
	20	8	16×10^{6}
	40	7	14×10^{6}
	60	5.5	16×10^{6}
	1×10^{2}	4	20×10^{6}
	2×10^{2}	3.5	19×10^{6}
	3×10^{2}	3.5	16×10^{6}
	4×10^{2}	3.5	14×10^{6}

§ 20.1005 Units of radioactivity.

For the purposes of this part, activity is expressed in the special unit of curies (Ci) or in the SI unit of becquerels (Bq), or their multiples, or disintegrations (transformations) per unit of time.

(a) One becquerel = 1 disintegration per second (s^{-1}).

(b) One curie = 3.7×10^{10} disintegrations per second = 3.7×10^{10} becquerels = 2.2×10^{12} disintegrations per minute.

[4]Value of quality factor (*Q*) at the point where the dose equivalent is maximum in a 30-cm diameter cylinder tissue equivalent phantom.

[5]Monoenergetic neutrons incident normally on a 30-cm diameter cylinder tissue-equivalent phantom.

§ 20.1006 Interpretations.

Except as specifically authorized by the Commission in writing, no interpretation of the meaning of the regulations in this part by an officer or employee of the Commission other than a written interpretation by the General Counsel will be recognized to be binding upon the Commission.

§ 20.1007 Communications.

Unless otherwise specified, communications or reports concerning the regulations in this part should be addressed to the Executive Director for Operations, U.S. Nuclear Regulatory Commission, Washington, DC 20555. A communication, report, or application may be delivered in person to the Office of the Executive Director for Operations, 11555 Rockville Pike, Rockville, MD 20852.

§ 20.1008 Implementation.

(a) Licensees shall implement the provisions of §§ 20.1001-20.2401 on or before January 1, 1994. If a licensee chooses to implement the provisions of §§ 20.1001-20.2401 prior to January 1, 1994, the licensee shall implement all provisions of these sections not otherwise exempted by paragraph (d) of this section, and shall provide written notification to either the Director of the Office Nuclear Materials Safety and Safeguards or the Director of the Office of Nuclear Reactor Regulation, as appropriate, that the licensee is adopting early implementation of §§ 20.1001-20.2401 and associated appendices. Until January 1, 1994, or until the licensee notifies the Commission of early implementation, compliance will be required with §§ 20.1-20.601 of this part.

(b) After the time the licensee implements §§ 20.1001-20.2401, the applicable section in §§ 20.1-20.601 of this part that is cited in license conditions or technical specifications, except as specified in paragraphs (c), (d), and (e) of this section. If the requirements of this part are more restrictive than the existing license condition, then the licensee shall comply with this part unless exempted by paragraph (d) of this section.

(c) Any existing license condition or technical specification that is more restrictive than a requirement in §§ 20.1001-20.2401 remains in force until there is a technical specification change, license amendment, or license renewal.

(d) If a license condition or technical specification exempted a licensee from a provision of part 20 in §§ 20.1-20.601, it exempts a licensee from the corresponding provision of §§ 20.1001-20.2401.

(e) If a license condition cites provision in §§ 20.1-20.601 and there are no corresponding provision in §§ 20.1001-20.2401, then the license condition remains in force until there is a technical specification change, license amendment, or license renewal that modifies or removes this condition.

§ 20.1009 Reporting, recording, and application requirements: OMB approval.

(a) The Nuclear Regulatory Commission has submitted the information collection requirements contained in this part to the Office of Management and Budget (OMB) for approval as required by the Paperwork Reduction Act of 1980 (44 U.S.C. 3501 *et seq*.). OMB has approved the information collection requirements contained in this part under control number 3150-0014.

(b) The approved information collection requirements contained in this part appear in §§ 20.1003, 20.1101, 20.1202, 20.1203, 20.1204, 20.1206, 20.1208, 20.1301, 20.1302, 20.1403, 20.1404, 20.1406, 20.1501, 20.1601, 20.1703, 20.1901, 20.1902, 20.1904, 20.1905, 20.1906, 20.2002, 20.2004, 20.2006, 20.2102, 20.2103, 20.2104, 20.2105, 20.2106, 20.2107, 20.2108, 20.2110, 20.2201, 20.2202, 20.2203, 20.2204, 20.2205, 20.2206, 20.2301, and Appendices F and G to 10 CFR Part 20.

(c) This part contains information collection requirements in addition to those approved under the control number specified in paragraph (a) of this section. These information collection requirements and the control numbers under which they are approved are as follows:

(1) In § 20.2104, NRC Form 4 is approved under control number 3150-0005.

(2) In §§ 20.2106 and 20.2206, NRC Form 5 is approved under control number 3150-0006.

(3) In § 20.2006 and appendix G to 10 CFR part 20, NRC Form 541 and 541A is approved under control number 3150-0164.

(4) In § 20.2006 and appendix G to 10 CFR part 20, NRC Form 5541 and 541A is approved under control number 3150-0165.

(5) In § 20.2006 and appendix G to 10 CFR part 20, NRC Form 542 and 542A is approved under control number 3150-0166.

Subpart B—Radiation Protection Programs

§ 20.1101 Radiation Protection Programs

(a) Each licensee shall develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with the provisions of this part. (See § 20.2102 for record keeping requirements relating to these programs.)

(b) The licensee shall use, to the extent practicable, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).

(c) The licensee shall periodically (at least annually) review the radiation protection program content and implementation.

(d) To implement the ALARA requirements of § 20.1101 (b), and notwithstanding the requirements in § 20.1301 of this part, a constraint on air emissions of radioactive material to the environment, excluding Radon-222 and its daughters, shall be established by licensees other than those subject to Sec. 50.34a, such that the individual member of the public likely to receive the highest dose will not be expected to receive a total effective dose equivalent in excess of 10 mrem (0.1 mSv) per year from these emissions. If a licensee subject to this requirement exceeds this dose constraint, the licensee shall report the exceedance as provided in Sec. 20.2203 and promptly take appropriate corrective action to ensure against recurrence.

Subpart C—Occupational Dose Limits

§ 20.1201 Occupational dose limits for adults.

(a) The licensee shall control the occupational dose to individual adults, except for the planned special exposures in § 20.1206, to the following dose limits.

(1) The annual limit is the more limiting of—

(i) The total effective dose equivalent being equal to 5 rems (0.05 Sv); or

(ii) The sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rems (0.5 Sv).

(2) The annual limits to the lens of the eye, to the skin, and to the extremities, which are:

(i) an eye dose equivalent limit of 15 rems (0.15 Sv), and

(ii) a shallow dose equivalent of 50 rems (0.5 Sv) to the skin or to any extremity.

(b) Doses received in excess of the annual limits, including doses received during accidents, emergencies, planned special exposures must be subtracted from the limits for planned special exposures that the individual may receive during the current year (see § 20.1206(e)(1)) and during the individual's lifetime(see § 20.1206(e)(2)).

(c) The assigned deep-dose equivalent and shallow dose-equivalent must be for the part of the body receiving the highest exposure. The deep-dose equivalent, eye dose equivalent and shallow-dose equivalent may be assessed from surveys or other radiation measurements for the purpose of demonstrating compliance with the occupational dose limits, if the individual monitoring device was not in the region of highest potential exposure, or the results of individual monitoring are unavailable.

(d) Derived air concentration (DAC) and annual limit of intake (ALI) values are presented in Table 1 of Appendix B to Part 20 and may be used to determine the individual's dose and to demonstrate compliance with the occupational dose limits.

(e) In addition to the annual dose limits, the licensee shall limit the soluble uranium intake by an individual to 10 milligrams in a week in consideration of chemical toxicity (see footnote 3 of appendix B to Part 20).

(f) The licensee shall reduce the dose that an individual may be allowed to receive in the current year by the amount of occupational dose received while employed by any other person (see § 20.2104(e)).

§ 20.1202 Compliance with requirements for summation of external and internal doses.

(a) If the licensee is required to monitor under both §§ 20.1502(a) and (b), the licensee shall demonstrate compliance with the dose limits by summing external and internal doses. If the licensee is required to monitor only under § 20.1502(a) or only under § 20.1502(b), then summation is not required to demonstrate compliance with the requirements with the dose limits. The licensee may demonstrate compliance with the requirements for summation of external and internal doses by meeting one of the conditions specified in paragraph (b) of this section and the conditions in paragraphs (c) and (d) of this section.

(**NOTE:** The dose equivalents for the lens of the eye, the skin, and the extremities are not included in the summation, but are subject to separate limits.)

(b) *Intake by inhalation.* If the only intake of radionuclides is by inhalation, the total effective dose equivalent is not exceeded if the sum of the deep-dose equivalent limit divided by the total effective dose equivalent limit, and one of the following, does not exceed unity:

(1) The sum of the fractions of the inhalation ALI for each radionuclide, or

(2) The total number of the derived air concentration-hours (DAC-hours) for all radionuclides divided by 2,000, or

(3) The sum of the calculated committed effective dose equivalents to all significantly irradiated[6] organs or tissues (T) calculated from bioassay data using appropriate biological models and expressed as a fraction of the annual limit.

(c) *Intake by oral ingestion*. If the occupationally exposed individual also receives an intake of radionuclides by oral ingestion greater than 10 percent of the applicable oral ALI, the licensee shall account for this intake and include it in demonstrating compliance with the limits.

(d) *Intake through wounds or absorption through skin*. The licensee shall evaluate and, to the extent practical, account for intakes through wounds or skin absorption.

(**NOTE:** The intake through intact skin has been included in the calculation of DAC for hydrogen-3 and does not need to be further evaluated.)

§ 20.1203 Determination of external dose from airborne radioactive material.

Licensees shall, when determining the dose from airborne radioactive material, include the contribution to the deep-dose equivalent, eye dose equivalent, and shallow-dose equivalent form external exposure to the radioactive cloud (see appendix B to Part 20, footnotes 1 and 2).

(**NOTE**: Airborne radioactivity measurements and DAC values should not be used as the primary means to assess the deep-dose equivalent when the airborne radioactive material includes other than noble gases or if the cloud of airborne radioactive material is not relatively uniform. The determination of the deep-dose equivalent to an individual should be based upon measurements using instruments or individual monitoring devices.

§ 20.1204 Determination of internal exposure.

(a) For purposes of assessing dose used to determine compliance with occupational dose equivalent limits, the licensee shall, when required under § 20.1502, take suitable and timely measurements of —

(1) Concentrations of radioactive materials in air in the work areas; or

(2) Quantities of radionuclides in the body; or

(3) Quantities of radionuclides excreted from the body; or

(4) Combinations of these measurements.

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[6]An organ or tissue is deemed to be significantly irradiated if, for that organ or tissue, the product of the weighting factor, w_T, and the committed dose equivalent, $H_{T,50}$, per unit intake is greater than 10 percent of the maximum weighted value of $H_{T,50}$ (*i.e.*, $w_T H_{T,50}$) per unit intake for any organ or tissue.

(b) Unless respiratory equipment is used, as provided in § 20.1703, or the assessment of intake is based on bioassays, the licensee shall assume that an individual inhales radioactive material at the airborne concentration in which the individual is present.

(c) When specific information on the physical and biochemical properties of the radionuclides taken into the body and the behavior of the material in an individual is known, the licensee may—

(1) Use that information to calculate the committed effective dose equivalent, and, if used, the licensee shall document that information in the individual's record; and

(2) Upon prior approval of the Commission, adjust the DAC or ALI values to reflect the actual physical and chemical characteristics of airborne radioactive material (*e.g.*, aerosol size distribution or density); and

(3) Separately assess the contribution of fractional intakes of Class D, W, or Y compounds of a given radionuclide (see appendix B to Part 20) to the committed dose equivalent.

(d) If the licensee chooses to assess intakes of Class Y material using the measurements given in § 20.1204(a)(2) or (3), the licensee may delay the recording and reporting of the assessments for periods up to 7 months, unless otherwise required by §§ 20.2202 or 20.2203, in order to permit the licensee to make additional measurements basic to the assessments.

(e) If the identity and concentration of each radionuclide in a mixture are known, the fraction of the DAC applicable to the mixture for use in calculating DAC-hours must be either—

(1) The sum of the ratios of the concentration to the appropriate DAC value (*e.g.*, D, W, or Y) from appendix B to Part 20 for each radionuclide in the mixture; or

(2) The ratio of the total concentration for all radionuclides in the mixture to the most restrictive DAC value for any radionuclide in the mixture.

(f) If the identity of each radionuclide in a mixture is known, but the concentration of one or more of the radionuclides in the mixture is not known, the DAC for mixture must be the most restrictive DAC of any radionuclide in the mixture.

(g) When a mixture of radionuclides in air exists, licensees may disregard certain radionuclides in the mixture if—

(1) The licensee uses the total activity of the mixture in demonstrating compliance with the dose limits in § 20.1201 and in complying with the monitoring requirements in § 20.1502(b), and

(2) The concentration of any radionuclide disregarded is less than 10 percent of its DAC, and

(3) The sum of these percentages for all of the radionuclides disregarded in the mixture does not exceed 30 percent.

(h)(1) In order to calculate the committed effective dose equivalent, the licensee may assume that the inhalation of one ALI, or an exposure of 2,000 DAC-hours, results in a committed effective dose equivalent of 5 rems (0.05 Sv) for radionuclides that have their ALIs or DACs based on the committed effective dose equivalent.

(2) When the ALI (and the associated DAC) is determined by the nonstochastic organ dose limit of 50 rems (0.5 Sv), the intake of radionuclides that would result in a committed effective dose equivalent of 5 rems (0.05 Sv) (the stochastic ALI) is listed in parentheses in table 1 of appendix B to Part 20. In this case, the licensee may, as a simplifying assumption, use the stochastic ALIs to determine committed effective dose equivalent. However, if the licensee uses the stochastic ALIs, the licensee must also demonstrate that the limit in § 20.1201(a)(1)(ii) is met.

§ 20.1205 [Reserved]

§ 20.1206 Planned special exposures.

A licensee may authorize an adult worker to receive doses from exposure to external sources in excess of the limits specified in § 20.1201 provided that each of the following conditions is satisfied—

(a) The licensee authorizes a planned special exposure only in an exceptional situation, when alternatives which might avoid the higher exposure are unavailable or impractical.

(b) The licensee (and employer, if the employer is not the licensee) specifically authorizes the planned special exposure, in writing, before the exposure occurs.

(c) Before a planned special exposure, the licensee ensures that the individuals involved are—

(1) Informed of the purpose of the planned operation;

(2) Informed of the estimated doses and special radiation or other conditions that might be involved in performing the task; and

(3) Instructed in the measures to be taken to keep the dose ALARA considering other risks that may be present.

(d) Prior to permitting an individual to participate in a planned special exposure, the licensee ascertains prior doses as required by § 20.2104(b) during the lifetime of the individual for each individual involved.

(e) Subject to § 20.1201(b), the licensee does not authorize a planned special exposure that would cause an individual to receive a dose from all planned special exposures and all doses in excess of the limits to exceed—

(1) The numerical values of any of the dose limits in § 20.1201(a) in any year; and

(2) Five times the annual dose limits in § 20.1201(a) during the individual’s lifetime.

(f) The licensee maintains records of the conduct of a planned special exposure in accordance with § 20.2105 and submits a written report in accordance with § 20.2204.

(g) The licensee records the best estimate of the dose resulting from the planned special exposure in the individual’s record and informs the individual, in writing, of the dose within 30 days from the date of the planned special exposure. The dose from planned special exposures is not to be considered in controlling future occupational dose of the individual under § 20.1201(a) but is to be included in evaluations required by § 20.1206(d) and (e).

§ 20.1207 Occupational dose limits for minors.

The annual occupational dose limits for minors are 10 percent of the annual dose limits specified for adult workers in § 20.1201.

§ 20.1208 Dose to an embryo/fetus.

(a) The licensee shall ensure that the dose to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, does not exceed 0.5 rem (5 mSv). (For record keeping requirements, see § 20.2106.)

(b) The licensee shall make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman so as to satisfy the limit in paragraph (a) of this section.

(c) The dose to an embryo/fetus shall be taken as the sum of—

(1) The deep dose equivalent to the declared pregnant woman; and

(2) The dose to the embryo/fetus from radionuclides in the embryo/fetus and radionuclides in the declared pregnant woman.

(c) If the dose to the embryo/fetus is found to have exceeded 0.5 rem (5 mSv), or is within 0.05 rem (0.5 mSv) of this dose, by the time the woman declares the pregnancy to the licensee, the licensee shall be deemed to be in compliance with paragraph (a) of this section if the additional dose to the embryo/fetus does not exceed 0.05 rem (0.5 mSv) during the remainder of the pregnancy.

Subpart D—Radiation Dose Limits for Individual Members of the Public

§ 20.1301 Dose limits for individual members of the public.

(a) Each licensee shall conduct operations so that—

(1) The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 millisievert) in a year, exclusive of the dose contributions from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with § 35.75, from voluntary participation in medical research programs, and from the licensee's disposal of radioactive material into sanitary sewerage in accordance with § 20.2003, and

(2) The dose in any unrestricted area from external sources, exclusive of the dose contributions from patients administered radioactive material and released in accordance with § 35.75, does not exceed 0.002 rem (0.02 millisievert) in any one hour.

(b) If the licensee permits members of the public to have access to controlled areas, the limits for members of the public continue to apply to those individuals.

(c) A licensee or license applicant may apply for prior NRC authorization to operate up to an annual dose limit for an individual member of the public of 0.5 rem (5 mSv). The licensee or license applicant shall include the following information in this application:

(1) Demonstration of the need for and the expected duration of operations in excess of the limit in paragraph (a) of this section;

(2) The licensee's program to assess and control dose within the 0.5 rem (5 mSv) annual limit; and

(3) The procedures to be followed to maintain the dose as low as reasonably achievable.

(d) In addition to the requirements of this part, a licensee subject to the provisions of EPA's generally applicable environmental radiation standards in 40 CFR Part 190 shall comply with those standards.

(e) The Commission may impose additional restrictions on radiation levels in unrestricted areas and on the total quantity of radionuclides that a licensee may release in effluents in order to restrict the collective dose.

§ 20.1302 Compliance with dose limits for individual members of the public.

(a) The licensee shall make or cause to be made, as appropriate, surveys of radiation levels in unrestricted and controlled areas and radioactive materials in effluents released to unrestricted and controlled areas to demonstrate compliance with the dose limits for individual members of the general public in § 20.1301.

(b) A licensee shall show compliance with the annual dose limit in § 20.1301 by—

(1) Demonstrating by measurement or calculation that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed operation does not exceed the annual dose limit; or

(2) Demonstrating that—

(i) The annual average concentrations of radioactive material released in gaseous and liquid effluents to the boundary of the unrestricted area do not exceed the values specified in table 2 of appendix B to Part 20; and

(ii) If an individual were continuously present in an unrestricted area, the dose from external sources would not exceed 0.002 rem (0.02 mSv) in an hour and 0.05 rem (0.5 mSv) in a year.

(c) Upon approval from the Commission, the licensee may adjust the effluent concentration values in appendix B to Part 20, table 2, for members of the public, to take into account the actual physical and chemical characteristics of the effluents (*e.g.*, aerosol size distribution, solubility, density, radioactive decay equilibrium, chemical form).

Subpart E—Radiological Criteria for License Termination

§ 20.1401 General provisions and scope.

(a) The criteria in this subpart apply to the decommissioning of facilities licensed under parts 30, 40, 50, 60, 61, 70, and 72 of this chapter, as well as other facilities subject to the Commission's jurisdiction under the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974, as amended. For high-level and low-level waste disposal facilities (10 CFR parts 60 and 61), the criteria apply only to ancillary surface facilities that support radioactive waste disposal activities. The criteria do not apply to uranium and thorium recovery facilities already subject to appendix A to 10 CFR part 40 or to uranium solution extraction facilities.

(b) The criteria in this subpart do not apply to sites which:

(1) Have been decommissioned prior to the effective date of the rule in accordance with criteria identified in the Site Decommissioning Management Plan (SDMP) Action Plan of April 16, 1992 (57 FR 13389);

(2) Have previously submitted and received Commission approval on a license termination plan (LTP) or decommissioning plan that is compatible with the SDMP Action Plan criteria; or

(3) Submit a sufficient LTP or decommissioning plan before August 20, 1998 and such LTP or decommissioning plan is approved by the Commission before August 20, 1999 and in accordance with the criteria identified in the SDMP Action Plan, except that if an EIS is required in the submittal, there will be a provision for day-for-day extension.

(c) After a site has been decommissioned and the license terminated in accordance with the criteria in this subpart, the Commission will require additional cleanup only if, based on new information, it determines that the criteria of this subpart were not met and residual radioactivity remaining at the site could result in significant threat to public health and safety.

(d) When calculating TEDE to the average member of the critical group the licensee shall determine the peak annual TEDE dose expected within the first 1000 years after decommissioning.

§ 20.1402 Radiological criteria for unrestricted use.

A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels which are ALARA must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal.

§ 20.1403 Criteria for license termination under restricted conditions.

A site will be considered acceptable for license termination under restricted conditions if:

(a) The licensee can demonstrate that further reductions in residual radioactivity necessary to comply with the provisions of § 20.1402 would result in net public or environmental harm or were not being made because the residual levels associated with restricted conditions are ALARA. Determination of the levels which are ALARA must take into account consideration of any detriments, such as traffic accidents, expected to potentially result from decontamination and waste disposal;

(b) The licensee has made provisions for legally enforceable institutional controls that provide reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 25 mrem (0.25 mSv) per year;

(c) The licensee has provided sufficient financial assurance to enable an independent third party, including a governmental custodian of a site, to assume and carry out responsibilities for

any necessary control and maintenance of the site. Acceptable financial assurance mechanisms are–

(1) Funds placed into an account segregated from the licensee's assets and outside the licensee's administrative control as described in § 30.35(f)(1) of this chapter;

(2) Surety method, insurance, or other guarantee method as described in § 30.35(f)(2) of this chapter;

(3) A statement of intent in the case of Federal, State, or local Government licensees, as described in § 30.35(f)(4) of this chapter; or

(4) When a governmental entity is assuming custody and ownership of a site, an arrangement that is deemed acceptable by such governmental entity.

(d) The licensee has submitted a decommissioning plan or License Termination Plan (LTP) to the Commission indicating the licensee's intent to decommission in accordance with §§ 30.36(d), 40.42(d), 50.82 (a) and (b), 70.38(d), or 72.54 of this chapter, and specifying that the licensee intends to decommission by restricting use of the site. The licensee shall document in the LTP or decommissioning plan how the advice of individuals and institutions in the community who may be affected by the decommissioning has been sought and incorporated, as appropriate, following analysis of that advice.

(1) Licensees proposing to decommission by restricting use of the site shall seek advice from such affected parties regarding the following matters concerning the proposed decommissioning–

(i) Whether provisions for institutional controls proposed by the licensee;

(A) Will provide reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 25 mrem (0.25 mSv) TEDE per year;

(B) Will be enforceable; and

(C) Will not impose undue burdens on the local community or other affected parties.

(ii) Whether the licensee has provided sufficient financial assurance to enable an independent third party, including a governmental custodian of a site, to assume and carry out responsibilities for any necessary control and maintenance of the site;

(2) In seeking advice on the issues identified in § 20.1403(d)(1), the licensee shall provide for:

(i) Participation by representatives of a broad cross section of community interests who may be affected by the decommissioning;

(ii) An opportunity for a comprehensive, collective discussion on the issues by the participants represented; and

(iii) A publicly available summary of the results of all such discussions, including a description of the individual viewpoints of the participants on the issues and the extent of agreement and disagreement among the participants on the issues; and

(e) Residual radioactivity at the site has been reduced so that if the institutional controls were no longer in effect, there is reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group is as low as reasonably achievable and would not exceed either–

(1) 100 mrem (1 mSv) per year; or

(2) 500 mrem (5 mSv) per year provided the licensee–

(i) Demonstrates that further reductions in residual radioactivity necessary to comply with the 100 mrem/y (1 mSv/y) value of paragraph (e)(1) of this section are not technically achievable, would be prohibitively expensive, or would result in net public or environmental harm;

(ii) Makes provisions for durable institutional controls;

(iii) Provides sufficient financial assurance to enable a responsible government entity or independent third party, including a governmental custodian of a site, both to carry out periodic rechecks of the site no less frequently than every 5 years to assure that the institutional controls remain in place as necessary to meet the criteria of § 20.1403(b) and to assume and carry out responsibilities for any necessary control and maintenance of those controls. Acceptable financial assurance mechanisms are those in paragraph (c) of this section.

§ 20.1404 Alternate criteria for license termination.

(a) The Commission may terminate a license using alternate criteria greater than the dose criterion of §§ 20.1402, 20.1403(b), and 20.1403(d)(1)(i)(A), if the licensee–

(1) Provides assurance that public health and safety would continue to be protected, and that it is unlikely that the dose from all man-made sources combined, other than medical, would be more than the 1 mSv/y (100 mrem/y) limit of subpart D, by submitting an analysis of possible sources of exposure;

(2) Has employed to the extent practical restrictions on site use according to the provisions of § 20.1403 in minimizing exposures at the site; and

(3) Reduces doses to ALARA levels, taking into consideration any detriments such as traffic accidents expected to potentially result from decontamination and waste disposal.

(4) Has submitted a decommissioning plan or License Termination Plan (LTP) to the Commission indicating the licensee's intent to decommission in accordance with §§ 30.36(d), 40.42(d), 50.82 (a) and (b), 70.38(d), or 72.54 of this chapter, and specifying that the licensee proposes to decommission by use of alternate criteria. The licensee shall document in the decommissioning plan or LTP how the advice of individuals and institutions in the community who may be affected by the decommissioning has been sought and addressed, as appropriate, following analysis of that advice. In seeking such advice, the licensee shall provide for:

(i) Participation by representatives of a broad cross section of community interests who may be affected by the decommissioning;

(ii) An opportunity for a comprehensive, collective discussion on the issues by the participants represented; and

(iii) A publicly available summary of the results of all such discussions, including a description of the individual viewpoints of the participants on the issues and the extent of agreement and disagreement among the participants on the issues.

(b) The use of alternate criteria to terminate a license requires the approval of the Commission after consideration of the NRC staff's recommendations that will address any comments provided by the Environmental Protection Agency and any public comments submitted pursuant to § 20.1405.

§ 20.1405 Public notification and public participation.

Upon the receipt of an LTP or decommissioning plan from the licensee, or a proposal by the licensee for release of a site pursuant to §§ 20.1403 or 20.1404, or whenever the Commission deems such notice to be in the public interest, the Commission shall:

(a) Notify and solicit comments from:

(1) local and State governments in the vicinity of the site and any Indian Nation or other indigenous people that have treaty or statutory rights that could be affected by the decommissioning; and

(2) the Environmental Protection Agency for cases where the licensee proposes to release a site pursuant to § 20.1404.

(b) Publish a notice in the Federal Register and in a forum, such as local newspapers, letters to State or local organizations, or other appropriate forum, that is readily accessible to individuals in the vicinity of the site, and solicit comments from affected parties.

§ 20.1406 Minimization of contamination.

Applicants for licenses, other than renewals, after August 20, 1997, shall describe in the application how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

Subpart F—Surveys and Monitoring

§ 20.1501 General.

(a) Each licensee shall make, or cause to be made, surveys that—

(1) May be necessary for the licensee to comply with the regulations in this part; and

(2) Are reasonable under the circumstances to evaluate—

(i) The extent of radiation levels; and

(ii) Concentrations or quantities of radioactive material; and

(iii) The potential radiological hazards that could be present.

(b) The licensee shall ensure that instruments and equipment used for quantitative radiation measurements (*e.g.*, dose rate and effluent monitoring) are calibrated for the type of radiation measured.

(c) All personnel dosimeters (except for direct and indirect reading pocket ionization chambers and those dosimeters used to measure the dose to the extremities) that require processing to determine the radiation dose and that are used by licensees to comply with § 20.1201, with other applicable provisions of this chapter, or with conditions specified in a license must be processed and evaluated by a dosimetry processor—

(1) Holding current personnel dosimetry accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology; and

(2) Approved in this accreditation process for the type of radiation or radiations included in the NVLAP program that most closely approximates the type of radiation or radiations for which the individual wearing the dosimeter is monitored.

§ 20.1502 Conditions requiring individual monitoring of external and internal occupational dose.

Each licensee shall monitor exposures to radiation and radioactive material at levels sufficient to demonstrate compliance with the occupational dose limits of this part. As a minimum—

(a) Each licensee shall monitor occupational exposure to radiation and shall supply and require the use of individual monitoring devices by—

(1) Adults likely to receive, in 1 year from sources external to the body, a dose in excess of 10 percent of the limits in § 20.1201(a),

(2) Minors and declared pregnant women likely to receive, in 1 year from sources external to the body, a dose in excess of 10 percent of any of the applicable limits in § 20.1207 or § 20.1208, and

(3) Individuals entering a high or very high radiation area.

(b) Each licensee shall monitor (see § 20.1204) the occupational intake of radioactive material by and assess the committed effective dose equivalent to—

(1) Adults likely to receive, in 1 year, an intake in excess of 10 percent of the applicable ALI(s) in table 1, Columns 1 and 2, of appendix B to Part 20; and

(2) Minors and declared pregnant women likely to receive, in 1 year, a committed effective dose equivalent in excess of 0.05 rem (0.5 mSv).

Subpart G—Control of Exposure From External Sources in Restricted Areas

§ 20.1601 Control of access to high radiation areas.

(a) The licensee shall ensure that each entrance or access point to a high radiation area has one or more of the following features—

(1) A control device that, upon entry into the area, causes the level of radiation to be reduced below that level at which an individual might receive a dose of 0.1 rem (1 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates;

(2) A control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the high radiation area and the supervisor of the activity are made aware of the entry; and

(3) Entryways that are locked, except during periods when access to the area is required, with positive control over each individual entry.

(b) In place of the controls required by part (a) of this section for a high radiation area, the licensee may substitute continuous direct or electronic surveillance that is capable of preventing unauthorized entry.

(c) A licensee may apply to the Commission for approval of alternative methods for controlling access to high radiation areas.

(d) The licensee shall establish the controls required by paragraphs (a) and (c) of this section in a way that does not prevent individuals from leaving a high radiation area.

(e) Control is not required for each entrance or access point to a room or other area that is a high radiation area solely because of the presence of radioactive materials prepared for transport and packaged and labeled in accordance with regulations of the Department of Transportation provided that—

(1) The packages do not remain in the area longer than 3 days; and

(2) The dose rate at 1 meter from the external surface of any package does not exceed 0.01 rem (0.1 mSv) per hour.

(f) Control of entrance or access to rooms or other areas in hospitals is not required solely because of the presence of patients containing radioactive material, provided that there are personnel in attendance who will take the necessary precautions to prevent the exposure of individuals to radiation or radioactive material in excess of the limits established in this part and to operate within the ALARA provisions of the licensee's radiation protection program.

§ 20.1602 Control of access to very high radiation areas.

In addition to the requirements in § 20.1601, the licensee shall institute additional measures to ensure that an individual is not able to gain unauthorized or inadvertent access to areas in which radiation levels could be encountered at 500 rads (5 grays) or more in 1 hour at 1 meter from a radiation source or any surface through which the radiation penetrates.

Subpart H—Respiratory Protection Controls to Restrict Internal Exposure in Restricted Areas

§ 20.1701 Use of process or other engineering controls.

The licensee shall use, to the extent practical, process or other engineering controls (*e.g.*, containment or ventilation) to limit the concentrations of the radioactive materials in air.

§ 20.1702 Use of other controls.

When it is not practical to apply process or other engineering controls to control the concentrations of radioactive material in air to values below those that define an airborne radioactivity area, the licensee shall, consistent with maintaining the total effective dose

equivalent ALARA, increase monitoring and limit intakes by one or more of the following means:

(a) Control of access;

(b) Limitation of exposure times;

(c) Use of respiratory protection equipment; or

(d) Other controls.

§ 20.1703 Use of individual respiratory protection equipment.

(a) If the licensee uses respiratory protection equipment to limit intakes pursuant to § 20.1702—

(1) The licensee shall use only respiratory protection equipment that is tested and certified or had certification by the National Institute for Occupational Safety and Health/Mine Safety and Health Administration (NIOSH/MSHA).

(2) If the licensee wishes to use equipment that has not been tested or certified by NIOSH/MSHA, has not had certification extended by NIOSH/MSHA, or for which there is no schedule for testing or certification, the licensee shall submit an application for authorized use of such equipment, including a demonstration by testing, or a demonstration on the basis of reliable test information, that the material and performance characteristics of the equipment are capable of providing the proposed degree of protection under anticipated conditions of use.

(3) The licensee shall implement and maintain a respiratory protection program that includes—

(i) Air sampling sufficient to identify the potential hazard, permit proper equipment selection, and estimate exposures;

(ii) Surveys and bioassays, as appropriate, to evaluate actual intakes;

(iii) Testing of respirators for operability immediately prior to each use;

(iv) Written procedures regarding selection, fitting, issuance, maintenance, and testing of respirators, including testing for operability immediately prior to each use; supervision and training of personnel; monitoring, including air sampling and bioassays; and record keeping; and

(v) Determination by a physician prior to the initial fitting of respirators, and either every 12 months thereafter or periodically at a frequency determined by a physician, that the individual user is medically fit to use the respiratory protection equipment.

(4) The licensee shall issue a written policy statement on respirator usage covering—

(i) The use of process or other engineering controls, instead of respirators;

(ii) The routine, nonroutine, and emergency use of respirators; and

(iii) The periods of respirator use and relief from respirator use.

(5) The licensee shall advise each respirator user that the user may leave the area at any time for relief from respirator use in the event of equipment malfunction, physical or

psychological distress, procedural or communication failure, significant deterioration of operating conditions, or any other conditions that might require such relief.

(6) The licensee shall use equipment within limitations for type and mode of use and shall provide proper visual, communication, and other special capabilities (such as adequate skin protection) when needed.

(b) In estimating exposure of individuals to airborne radioactive materials, the licensee may make allowance for respiratory protection equipment used to limit the inhalation of the material pursuant to § 20.1702, provided that the following conditions, in addition to those in § 20.1703(a), are satisfied:

(1) The licensee selects respiratory protection equipment that provides a protection factor (see Appendix A, Part 20) greater than the multiple by which peak concentrations of airborne radioactive materials in the working area are expected to exceed the values specified in Appendix B to Part 20, Table 1, column 3. If the selection of a respiratory protection device with a protection factor greater than the multiple defined in the preceding sentence is inconsistent with the goal specified in § 20.1702 of keeping the total effective dose equivalent ALARA, the licensee may select respiratory protection equipment with a lower protection factor only if such a selection would result in keeping the total effective dose equivalent ALARA. The concentration of radioactive material in the air that is inhaled when respirators are worn may be initially estimated by dividing the average concentration in air, during each period of uninterrupted use, by the protection factor. If the exposure is later found to be greater than estimated, the corrected value must be used; if the exposure is later found to be less than estimated, the corrected value may be used.

(2) The licensee shall obtain authorization from the Commission before assigning respiratory protection factors in excess of those specified in Appendix A to Part 20. The Commission may authorize a licensee to use higher protection factors on receipt of an application that—

(i) Describes the situation for which a need exists for higher protection factors, and

(ii) Demonstrates that the respiratory protective equipment provides these higher protection factors under the proposed conditions of use.

(c) The licensee shall use as emergency devices only respiratory protection equipment that has been specifically certified or had certification extended for emergency use by NIOSH/MSHA.

(d) The licensee shall notify, in writing, the Regional Administrator of the appropriate NRC Regional Office listed in appendix D to Part 20 at least 30 days before the date that respiratory protection equipment is first used under the provisions of either § 20.1703(a) or (b).

§ 20.1704 Further restrictions on the use of respiratory protection equipment.

The Commission may impose further restrictions, in addition to those in §§ 20.1702, 20.1703, and Appendix A to Part 20 to—

(a) Ensure that the respiratory protection program of the licensee is adequate to limit exposures of individuals to airborne radioactive materials; and

(b) Limit the extent to which a licensee may use respiratory protection equipment instead of process or other engineering controls.

Subpart I—Storage and Control of Licensed Material

§ 20.1801 Security of stored material.

The licensee shall secure from unauthorized removal or access licensed materials that are stored in controlled or unrestricted areas.

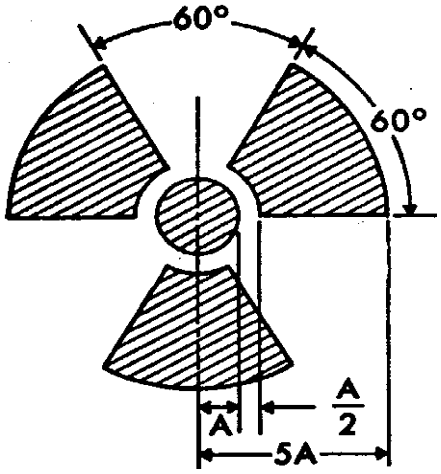
§ 20.1802 Control of material not in storage.

The licensee shall control and maintain constant surveillance of licensed material that is in a controlled or unrestricted area and that is not in storage.

Subpart J—Precautionary Procedures

§ 20.1901 Caution signs.

(a) *Standard radiation symbol.* Unless otherwise authorized by the Commission, the symbol prescribed by this part shall use the colors magenta, or purple, or black on yellow background. The symbol prescribed by this part is the three-bladed design:



RADIATION SYMBOL

(1) Cross-hatched area is to be magenta, or purple, or black, and

(2) Background is to be yellow.

(b) *Exception to color requirements for standard radiation symbol.* Notwithstanding the requirements of paragraph (a) of this section, licensees are authorized to label sources, source holders, or device components containing sources of licensed materials that are subjected to high temperatures, with conspicuously etched or stamped radiation caution symbols and without a color requirement.

(c) *Additional information on signs and labels.* In addition to the contents of signs and labels prescribed in this part, the licensee may provide, on or near the required signs and labels, additional information, as appropriate, to make individuals aware of potential radiation exposures and to minimize the exposures.

§ 20.1902 Posting requirements.

(a) *Posting of radiation areas.* The licensee shall post each radiation area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIATION AREA."

(b) *Posting of high radiation areas.* The licensee shall post each high radiation area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, HIGH RADIATION AREA" or "DANGER, HIGH RADIATION AREA."

(c) *Posting of very high radiation areas.* The licensee shall post each very high radiation area with a conspicuous sign or signs bearing the radiation symbol and words "GRAVE DANGER, VERY HIGH RADIATION AREA."

(d) *Posting of airborne radioactivity areas.* The licensee shall post each airborne radioactivity area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, AIRBORNE RADIOACTIVITY AREA" or "DANGER, AIRBORNE RADIOACTIVITY AREA."

(e) *Posting of areas or rooms in which licensed material is stored.* The licensee shall post each area or room in which there is used or stored an amount of licensed material exceeding 10 times the quantity of such material specified in Appendix C to Part 20 with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL(S)" or "DANGER, RADIOACTIVE MATERIAL(S)."

§ 20.1903 Exceptions to posting requirements.

(a) A licensee is not required to post caution signs in areas or rooms containing radioactive materials for periods of less than 8 hours, if each of the following conditions is met:

(1) The materials are constantly attended during these periods by an individual who takes the precautions necessary to prevent the exposure of individuals to radiation or radioactive materials in excess of the limits established in this part; and

(2) The area or room is subject to the licensee's control.

(b) Rooms or other areas in hospitals that are occupied by patients are not required to be posted with caution signs pursuant to § 20.1902 provided that the patient could be released from licensee control to § 35.75 of this chapter.

(c) A room or area is not required to be posted with a caution sign because of the presence of a sealed source provided the radiation level at 30 centimeters from the surface of the source container or housing does not exceed 0.005 rem (0.05 mSv) per hour.

§ 20.1904 Labeling containers.

(a) The licensee shall ensure that each container of licensed material bears a durable, clearly visible label bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL." The label must also provide sufficient information (such as the radionuclide(s) present, an estimate of the quantity of radioactivity, the date for which the activity is estimated, radiation levels, kinds of materials, and mass enrichment) to permit individuals handling or using the containers, or working in the vicinity of the containers, to take precautions to avoid or minimize exposures.

(b) Each licensee shall, prior to removal or disposal of empty uncontaminated containers to unrestricted areas, remove or deface the radioactive material label or otherwise clearly indicate that the container no longer contains radioactive materials.

§ 20.1905 Exemptions to labeling requirements.

A licensee is not required to label the following—

(a) Containers holding licensed material in quantities less than the quantities listed in Appendix C to Part 20; or

(b) Containers holding licensed material in concentrations less than those specified in table 3 of Appendix B to Part 20; or

(c) Containers attended by an individual who takes the precautions necessary to prevent the exposure of individuals in excess of the limits established by this part; or

(d) Containers when they are in transport and packaged and labeled in accordance with the regulations of the Department of Transportation[7] or

(e) Containers that are accessible only to individuals authorized to handle or use them, or to work in the vicinity of the containers, if the contents are identified to these individuals by a readily available written record (examples of containers of this type are containers in locations such as water-filed canals, storage vaults, or hot cells). The record must be retained as long as the containers are in use for the purpose indicated on the record; or

(f) Installed manufacturing or process equipment, such as reactor components, piping, and tanks.

§ 20.1906 Procedures for picking up, receiving, and opening packages.

(a) Each licensee who expects to receive a package containing quantities of radioactive material in excess of a Type A quantity, as defined in § 71.4 and Appendix A of Part 71 of this chapter, shall make arrangements to receive—

(1) The package when the carrier offers it for delivery; or

(2) Notification of the arrival of the package at the carrier's terminal and to pick up the package expeditiously.

(b) Each licensee shall—

(1) Monitor the external surfaces of a labeled[8] package for radioactive contamination unless the package contains only radioactive material in the form of a gas or in special form as defined in 10 CFR 71.4;

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[7]Labeling of packages containing radioactive materials is required by the Department of Transportation (DOT) if the amount and type of radioactive material exceeds the limits for an excepted quantity or article as defined and limited by DOT regulations 49 CFR 173.403(m) and (w) and 173.421-424.

[8]Labeled with a Radioactive White I, Yellow II, or Yellow III label as specified in U.S. Department of Transportation regulations, 49 CFR 172.403 and 172.436-440.

(2) Monitor the external surfaces of a labeled[8] package for radiation levels unless the package contains quantities of radioactive material that are less than or equal to the Type A quantity, as defined in § 71.4 and appendix A to part 71 of this chapter; and

(3) Monitor all packages known to contain radioactive material for radioactive contamination and radiation levels if there is evidence of degradation of package integrity, such as packages that are crushed, wet, or damaged.

(c) The licensee shall perform the monitoring required by paragraph (b) of this section as soon as practical after receipt of the package, but not later than 3 hours after the package is received at the licensee's facility if it is received during the licensee's normal working hours, or not later than 3 hours from the beginning of the next working day if it is received after working hours.

(d) The licensee shall immediately notify the final delivery carrier and, by telephone and telegram, mailgram, or facsimile, the Administrator of the appropriate NRC Regional Office listed in Appendix D to Part 20 when—

(1) Removable radioactive surface contamination exceeds the limits of § 71.87(i) of this chapter; or

(2) External radiation levels exceeds the limits of § 71.87(i) of this chapter.

(e) Each licensee shall—

(1) Establish, maintain, and retain written procedures for safely opening packages in which radioactive material is received; and

(2) Ensure that the procedures are followed and that due consideration is given to special instructions for the type of package being opened; and

(f) Licensees transferring special form sources in licensee-owned or licensee-operated vehicles to and from a work site are exempt from the contamination monitoring requirements of paragraph (b) of this section, but are not exempt from the survey requirement in paragraph (b) of this section for measuring radiation levels that is required to ensure that the source is still properly lodged in its shield.

Subpart K—Waste Disposal

§ 20.2001 General requirements.

(a) A licensee shall dispose of licensed material only—

(1) By transfer to an authorized recipient as provided in § 20.2006 or in the regulations in Parts 30, 40,, 60, 61, 70, or 72 of this chapter; or

(2) By decay in storage; or

(3) By release in effluents within the limits in § 20.1301; or

(4) As authorized under §§ 20.2002, 20.2003, 20.2004, or 20.2005.

(b) A person must be specifically licensed to receive waste containing licensed material from other persons for:

(1) Treatment prior to disposal; or

(2) Treatment or disposal by incineration; or

(3) Decay in storage; or

(4) Disposal at a land disposal facility licensed under part 61 of this chapter; or

(5) Disposal at a geologic repository under part 60 of this chapter.

§ 20.2002 Method for obtaining approval of proposed disposal procedures.

A licensee or applicant for a license may apply to the Commission for approval of proposed procedures, not otherwise authorized in the regulations in this chapter, to dispose of radioactive waste generated in the licensee's activities. Each application shall include:

(a) A description of the waste containing licensed material to be disposed of, including the physical and chemical properties important to risk evaluation, and the proposed manner and conditions of waste disposal; and

(b) An analysis and evaluation of pertinent information on the nature of the environment; and

(c) The nature and location of other potentially affected licensed and unlicensed facilities; and

(d) Procedures to ensure that doses are maintained ALARA and within the dose limits in this part.

§ 20.2003 Disposal by release into sanitary sewerage.

(a) A licensee may discharge licensed material into sanitary sewerage if each of the following conditions is satisfied:

(1) The material is readily soluble (or is readily dispersible biological material) in water; and

(2) The quantity of licensed or other radioactive material that the licensee releases into the sewer in 1 month divided by the average monthly volume of water released into the sewer by the licensee does not exceed the concentration listed in table 3 of Appendix B to Part 20; and;

(3) If more than one radionuclide is released, the following conditions must also be satisfied:

(i) The licensee shall determine the fraction of the limit in table 3 of Appendix B to §§ 20.1001-20.2401 represented by discharges into sanitary sewerage by dividing the actual monthly average concentration of each radionuclide released by the licensee into the sewer by the concentration of that radionuclide listed in table 3 of appendix B to §§ 20.1001-20.2401; and

(ii) The sum of the fractions for each radionuclide required by paragraph (a)(3)(i) of this section does not exceed unity; and

(4) The total quantity of licensed and other radioactive material that the licensee releases into the sanitary sewerage system in a year does not exceed 5 curies (185 GBq) of carbon-14, and 1 curie (37 GBq) of all other radioactive materials combined.

(b) Excreta from individuals undergoing medical diagnosis or therapy with radioactive material are not subject to the limitations contained in paragraph (a) of this section.

§ 20.2004 Treatment or disposal by incineration.

(a) A licensee may treat or dispose of licensed material by incineration only:

(1) As authorized by paragraph (b) of this section; or

(2) If the material is in a form and concentration specified in § 20.2005; or

(3) As specifically approved by the Commission pursuant to § 20.2002.

(b)(1) Waste oils (petroleum derived or synthetic oils used principally as lubricants, coolants, hydraulic or insulating fluids, or metalworking oils) that have been radioactively contaminated in the course of the operation or maintenance of a nuclear power reactor licensed under part 50 of this chapter may be incinerated on the site where generated provided that the total radioactive effluents from the facility, including the effluents from such incineration, conform to the requirements of Appendix I to Part 50 of this chapter and effluent release limits contained in applicable license conditions other than effluent limits specifically related to incineration of waste oil. The licensee shall report any changes or additions to the information supplied under §§ 50.34 and 50.34a of this chapter associated with this incineration pursuant to § 50.71 of this chapter as appropriate. the licensee shall also follow the procedures of § 50.59 of this chapter with respect to such changes to the facility or procedures.

(2) Solid residues produced in the process of incinerating waste oils must be disposed of as provided by § 20.2001.

(3) The provisions of this section authorize onsite waste oil incineration under the terms of this section and supersede any provision in an individual plant license or technical specification that may be inconsistent.

§ 20.2005 Disposal of specific wastes.

(a) A licensee may dispose of the following licensed material as if it were not radioactive:

(1) 0.05 microcurie (1.85 kBq), or less, of hydrogen-3 or carbon-14 per gram of medium used for liquid scintillation counting; and

(2) 0.05 microcurie (1.85 kBq), or less, of hydrogen-3 or carbon-14 per gram of animal tissue, averaged over the weight of the entire animal.

(b) A licensee may not dispose of tissue under paragraph (a)(2) of this section in a manner that would permit its use either as food for humans or as animal feed.

(c) The licensee shall maintain records in accordance with § 20.2108.

§ 20.2006 Transfer for disposal and manifests.

(a)(1) The requirements of this section and Appendix F and G to 10 CFR part 20 are designed to

(i) Control transfers of low-level radioactive waste by any waste generator, waste collector, or waste processor licensee, as defined in this part, who ships low-level waste either directly, or indirectly through a waste collector or waste processor, to a licensed low-level waste land disposal facility (as defined in part 61 of this chapter);

(ii) Establish a manifest tracking system; and

(iii) Supplement existing requirements concerning transfers and record keeping for such wastes.

(2) Beginning March 1, 1998, all affected licensees must use Appendix G. Prior to March 1, 1998, a LLW disposal facility operator or its regulatory authority may require the shipper to use appendix F or appendix G. Licensees using appendix F shall comply with paragraph (b)(1) of this section. Licensees using appendix G shall comply with paragraph (b)(2) of this section.

(b)(1) Each shipment of radioactive waste intended for disposal at a licensed land disposal facility must be accompanied by a shipment manifest in accordance with section I of Appendix F to 10 CFR part 20.

(2) Any licensee shipping radioactive waste intended for ultimate disposal at a licensed land disposal facility must document the information required on NRC's Uniform Low-Level Radioactive Waste Manifest and transfer this recorded manifest information to the intended consignee in accordance with appendix G to 10 CFR part 20.

(c) Each shipment manifest shall include a certification by the waste generator as specified in section II of appendix F or appendix G to 10 CFR part 20, as appropriate. See paragraph (a)(2) of this section to determine the appropriate appendix.

(d) Each person involved in the transfer for disposal and disposal of waste, including the waste generator, waste collector, waste processor, and disposal facility operator, shall comply with the requirements specified in section III of appendix F or appendix G to 10 CFR part 20, as appropriate. See paragraph (a)(2) of this section to determine the appropriate appendix.

§ 20.2007 Compliance with environmental and health protection regulations.

Nothing in this subpart relieves the licensee from complying with other applicable Federal, State, and local regulations governing any other toxic or hazardous properties of materials that may b e disposed of under this subpart.

Subpart L—Records

§ 20.2101 General provisions.

(a) Each licensee shall use the units: curie, rad, rem, including multiples and subdivisions, and shall clearly indicate the units of all quantities on records required by this part.

(b) Not withstanding the requirements of paragraph (a) of this section, when recording information on shipment manifests, as required in § 20.2006(b), information must be recorded in the International System of Units (SI) or SI and units as specified in paragraph (a) of this section.

§ 20.2102 Records of radiation protection programs.

(a) Each licensee shall maintain records of the radiation protection program, including—

(1) The provisions of the radiation protection program; and

(2) Audits and other reviews of program content and implementation.

(b) The licensee shall retain the records required by paragraph (a)(1) of this section until the Commission terminates each pertinent license requiring the record. the licensee shall retain the records required by paragraph (a)(2) of this section for 3 years after the record is made.

§ 20.2103 Records of surveys.

(a) Each licensee shall maintain records showing the results of surveys and calibrations required by §§ 20.1501 and 20.1906(b). The licensee shall retain these records for 3 years after the record is made.

(b) The licensee shall retain each of the following records until the Commission terminates each pertinent license requiring the record:

(1) Records of the results of surveys to determine the dose from external sources and used, in the absence of individual monitoring data, in the assessment of individual dose equivalents. This includes those records of results of surveys to determine the dose from external sources and used, in the absence of or in combination with individual monitoring data, in the assessment of individual dose equivalents required under the standards for protection against radiation in effect prior to January 1, 1994; and

(2) Records of the results of measurements and calculations used to determine individual intakes of radioactive material and used in the assessment of internal dose. This includes those records of measurements and calculations to determine individual intakes of radioactive material and used in the assessment of internal dose required under the standards for protection against radiation in effect prior to January 1, 1994; and

(3) Records showing the results of air sampling, surveys, and bioassays required pursuant to § 20.1703(a)(3)(i) and (ii). This includes those records showing the results of air sampling, surveys, and bioassays required under the standards for protection against radiation in effect prior to January 1, 1994; and

(4) Records of the results of measurements and calculations used to evaluate the release of radioactive effluents to the environment. This includes those records of the results of measurements and calculations used to evaluate the release of radioactive effluents to the environment required under the standards for protection against radiation in effect prior to January 1, 1994.

§ 20.2104 Determination of prior occupational dose.

(a) For each individual who is likely to receive in a year, an occupational dose requiring monitoring pursuant to § 20.1502, the licensee shall—

(1) Determine the occupational radiation dose received during the current year; and

(2) Attempt to obtain the records of cumulative occupational radiation dose.

(b) Prior to permitting an individual to participate in a planned special exposure, the licensee shall determine—

(1) The internal and external doses from all previous planned special exposures; and

(2) All dose in excess of the limits (including doses received during accidents and emergencies) received during the lifetime of the individual.

(c) In complying with the requirements of paragraph (a) of this section, a licensee may—

(1) Accept, as a record of the occupational dose that the individual received during the current year, a written signed statement from the individual, or from the individual's most recent

employer for work involving radiation exposure, that discloses the nature and the amount of any occupational dose that the individual may have received during the current year;

(2) Accept, as the record of cumulative radiation dose, an up-to-date NRC Form 4, or equivalent, signed by the individual and countersigned by an appropriate official of the most recent employer for work involving radiation exposure, or the individual's current employer (if the individual is not employed by the licensee); and

(3) Obtain reports of the individual's dose equivalent(s) from the most recent employer for work involving radiation exposure, or the individual's current employer (if the individual is not employed by the licensee) by telephone, telegram, electronic media, or letter. The licensee shall request a written verification of the dose data if the authenticity of the transmitted report cannot be established.

(d) The licensee shall record the exposure history of each individual, as required by paragraph (a) of this section, on NRC Form 4, or other clear and legible record, including all of the information required by NRC Form 4.[9] The form of the record must show each period in which the individual received occupational exposure to radiation or radioactive material and must be signed by the individual who received the exposure. for each period for which the licensee obtains reports, the licensee shall use the dose shown in the report in preparing the NRC Form 4. For any period in which the licensee does not obtain a report, the licensee shall place a notation on the NRC Form 4 indicating the periods of time for which data are not available.

(e) If the licensee is unable to obtain a complete record of an individual's current and previously accumulated occupational dose, the licensee shall assume—

(1) In establishing administrative controls under § 20.1201(f) for the current year, that the allowable dose limit for the individual is reduced by 1.25 rems (12.5 mSv) for each quarter for which records were unavailable and the individual was engaged in activities that could have resulted in occupational radiation exposure; and

(2) That the individual is not available for planned special exposures.

(f) The licensee shall retain the records on NRC Form 4 or equivalent until the Commission terminates each pertinent license requiring this record. The licensee shall retain records used in preparing NRC Form 4 for 3 years after the record is made. This includes records required under the standards for protection against radiation in effect prior to January 1, 1994.

§ 20.2105 Records of planned special exposures.

(a) For each use of the provisions of § 20.1206 for planned special exposures the licensee shall maintain records that describe—

(1) The exceptional circumstances requiring the use of a planned special exposure; and

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[9]Licensees are not required to partition historical dose between external dose equivalent(s) and internal committed dose equivalent(s). Further, occupational exposure histories obtained and recorded on NRC Form 4 before January 1, 1994, might not have included effective dose equivalent, but may be used in the absence of specific information on the intake of radionuclides by the individual.

(2) The name of the management official who authorized the planned special exposure and a copy of the signed authorization; and

(3) What actions were necessary; and

(4) Why the actions were necessary; and

(5) How doses were maintained ALARA; and

(6) What individual and collective doses were expected to result, and the doses actually received in the planned special exposure.

(b) The licensee shall retain the records until the Commission terminates each pertinent license requiring these records.

§ 20.2106 Records of individual monitoring results.

(a) *Recordkeeping requirement.* Each licensee shall maintain records of doses received by all individuals for whom monitoring was required pursuant to § 20.1502, and records of doses received during planned special exposures, accidents and emergency conditions. These records[10] must include when applicable—

(1) The deep-dose equivalent to the whole body, eye dose equivalent, shallow-dose equivalent to the skin, and shallow-dose equivalent to the extremities; and

(2) The estimated intake or body burden of radionuclides (see § 20.1202); and

(3) The committed effective dose equivalent assigned to the intake or body burden of radionuclides; and

(4) The specific information used to calculate the committed effective dose equivalent pursuant to § 20.1204(c); and

(5) The total effective dose equivalent when required by § 20.1202; and

(6) The total of the deep-dose equivalent and the committed dose to the organ receiving the highest total dose.

(b) *Recordkeeping frequency.* The licensee shall make entries of the records specified in paragraph (a) of this section at least annually.

(c) *Recordkeeping format.* The licensee shall maintain the records specified in paragraph (a) of this section on NRC Form 5, or in clear and legible records containing all the information required by NRC Form 5.

(d) *Privacy protection.* The records required under this section should be protected from public disclosure because of their personal privacy nature. These records are protected by most State privacy laws and, when transferred to the NRC, are protected by the Privacy Act of 1974, Public Law 93-579, 5 U.S.C. 552a, and the Commission's regulations in 10 CFR part 9.

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[10]Assessments of dose equivalents and records made using units in effect before the licensee's adoption of this part need not be changed.

(e) The licensee shall maintain the records of dose to an embryo/fetus with the records of dose to the declared pregnant woman. The declaration of pregnancy shall also be kept on file, but may be maintained separately from the dose records.

(f) The licensee shall retain each required form or record until the Commission terminates each pertinent license requiring the record. This includes records required under the standards for protection against radiation in effect prior to January 1, 1994.

§ 20.2107 Records of release of radioactive material in effluents.

(a) Each licensee shall maintain records sufficient to demonstrate compliance with the dose limit for individual members of the public (see § 20.1301).

(b) The licensee shall retain the records required by paragraph (a) of this section until the Commission terminates each pertinent license requiring the record.

§ 20.2108 Records of waste disposal.

(a) Each licensee shall maintain records of the disposal of licensed material made under §§ 20.2002, 20.2003, 20.2004, 20.2005, 10 CFR part 61 and disposal by burial in soil, including burials authorized before January 28, 1981.[11]

(b) The licensee shall retain the records required by paragraph (a) of this section until the Commission terminates each pertinent license requiring the record. Requirements for disposition of these records, prior to license termination are located in §§ 30.51, 40.61, 70.51, and 72.80 for activities licensed under these parts.

§ 20.2109 [Reserved]

§ 20.2110 Form of records.

Each record required by this part must be legible throughout the specified retention period. The record may be the original or a reproduced copy or a microform provided that the copy or microform is authenticated by authorized personnel and the microform is capable of producing a clear copy throughout the required retention period. The record may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records, such as letters, drawings, and specifications, must include all pertinent information, such as stamps, initials, and signatures. The licensee shall maintain adequate safeguards against tampering with and loss of records.

Subpart M—Reports

§ 20.2201 Reports of theft or loss of licensed material.

(a) *Telephone reports*.

(1) Each licensee shall report by telephone as follows:

(i) Immediately after its occurrence becomes known to the licensee, any lost, stolen, or missing licensed material in an aggregate quantity equal to or greater than 1,000 times the

[11]A previous § 20.304 permitted burial of small quantities of licensed materials in soil before January 28, 1981, without specific Commission authorization.

quantity specified in Appendix C to Part 20 under such circumstances that it appears to the licensee that an exposure could result to persons in unrestricted areas; or

(ii) Within 30 days after the occurrence of any lost, stolen or missing licensed material becomes known to the licensee, all licensed material in a quantity greater than 10 times the quantity specified in Appendix C to Part 20 which is still missing at this time.

(2) Reports must be made as follows:

(i) Licensees having an installed Emergency Notification System shall make the reports to the NRC Operations Center in accordance with § 50.72 of this chapter; and

(ii) All other licensees shall make reports to the NRC Operations Center.

(b) *Written reports.*

(1) Each licensee who is required to make a report under paragraph (a) of this section shall, within 30 days after making the telephone report, make a written report setting forth the following information:

(i) A description of the licensed material involved, including kind, quantity, and chemical and physical form; and

(ii) A description of the circumstances under which the loss or theft occurred; and

(iii) A statement of disposition, or probable disposition, of the licensed material involved; and

(iv) Exposure of individuals to radiation, circumstances under which the exposure occurred, and the possible total effective dose equivalent to persons in unrestricted areas; and

(v) Actions that have been taken, or will be taken, to recover the material; and

(vi) Procedures or measures which have been, or will be, adopted to ensure against a recurrence of the loss or theft of licensed material.

(2) Reports must be made as follows:

(i) For holders of an operating license for a nuclear power plant, the events included in paragraph (b) of this section must be reported in accordance with the procedures described in § 50.73(b), (c), (d), (e), and (g) of this chapter and must include the information required in paragraph (b)(1) of this section.

(ii) All other licensees shall make reports to the Administrator of the appropriate NRC Regional Office listed in Appendix D to Part 20.

(c) A duplicate report is not required under paragraph (b) of this section if the licensee is also required to submit a report pursuant to §§ 30.55(c), 40.64(c), 50.72, 50.73, 70.52, 73.27(b), 73.67(e)(3)(vi), 73.67(g)(3)(iii), 73.71, or 150.19(c) of this chapter.

(d) Subsequent to filing the written report, the licensee shall also report any additional, substantive information on the loss or theft within 30 days after the licensee learns of such information.

(e) The licensee shall prepare any reports filed with the Commission pursuant to this section so that names of individuals who may have received exposure to radiation are stated in a separate and detachable part of the report.

§ 20.2202 Notification of incidents.

(a) *Immediate notification.* Notwithstanding any other requirements for notification, each licensee shall immediately report any event involving byproduct, source, or special nuclear material possessed by the licensee which may have caused, or threatens to cause, any of the following conditions—

(1) An individual to receive—

(i) A total effective dose equivalent of 25 rems (0.25 Sv) or more; or

(ii) An eye dose equivalent of 75 rems (0.75 Sv) or more; or

(iii) A shallow dose equivalent to the skin or extremities of 250 rads (2.5 Gy) or more; or

(2) The release of radioactive material, inside or outside of a restricted area, so that, had an individual been present for 24 hours the individual could have received an intake five times the annual limit of intake (the provisions of this paragraph do not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or process enclosures

(b) *Twenty-four hour notification.* Each licensee shall, within 24 hours of discovery of the event, report any event involving loss of control of licensed material possessed by the licensee that may have caused, or threatens to cause, any of the following conditions:

(1) An individual to receive, in a period of 24 hours—

(i) A total effective equivalent exceeding 5 rems (0.05 Sv); or

(ii) An eye equivalent exceeding 15 rems (0.15 Sv); or

(iii) A shallow dose equivalent to the skin or extremities exceeding 50 rems (0.5 Sv); or

(2) The release of radioactive material, inside or outside of a restricted area, so that, had an individual been present for 24 hours the individual could have received an intake in excess of one occupational annual limit of intake (the provisions of this paragraph do not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or process enclosures).

(c) The licensee shall prepare any report filed with the Commission pursuant to this section so that names of individuals who have received exposure to radiation or radioactive material are stated in a separate and detachable part of the report.

(d) Reports made by licensees in response to the requirements of this section must be made as follows:

(1) Licensees that have an installed Emergency Notification System shall make the reports required by paragraphs (a) and (b) of this section to the NRC Operations Center in accordance with 10 CFR 50.72; and

(2) All other licensees shall make the reports required by paragraphs (a) and (b) of this section by telephone and by telegram, mailgram, or facsimile to the Administrator of the appropriate NRC Regional Office listed in Appendix D to §§ 20.1001-20.2401.

(e) The provisions of this section do not include doses that result from planned special exposures, that are within the limits for planned special exposures, and that are reported under § 20.2204.

§ 20.2203 Reports of exposures, radiation levels, and concentrations of radioactive material exceeding the constraints or limits.

(a) Reportable events. In addition to notification required by § 20.2202, each licensee shall submit a written report within 30 days after learning of any of the following occurrences:

(1) Any incident for which notification is required by § 20.2202; or

(2) Doses in excess of any of the following:

(i) The occupational dose limits for adults in § 20.1201; or

(ii) The occupational dose limits for a minor in § 20.1207; or

(iii) The limits for an embryo/fetus of a declared pregnant woman in § 20.1208; or

(iv) The limits for an individual member of the public in § 20.1301; or

(v) Any applicable limit in the license;

(vi) The ALARA constraints for air emissions established under § 20.1101(d); or

(3) Levels of radiation or concentrations of radioactive materials in—

(i) A restricted area in excess of any applicable limit in the license; or

(ii) An unrestricted area in excess of 10 times any applicable limit set forth in this part or in the license (whether or not involving exposure of any individual in excess of the limits in § 20.1301); or

(4) For licensees subject to the provision of EPA's generally applicable environmental radiation standards in 40 CFR part 190, levels of radiation or releases of radioactive material in excess of those standards, or of license conditions related to those standards.

(b) Contents of reports.

(1) Each report required by paragraph (a) of this section must describe the extent of exposure of individuals to radiation and radioactive material, including, as appropriate:

(i) Estimates of each individual's dose; and

(ii) The levels of radiation and concentrations of radioactive material involved; and

(iii) The cause of the elevated exposures, dose rates, or concentrations; and

(iv) Corrective steps taken or planned to ensure against a recurrence, including the schedule for achieving conformance with applicable limits, ALARA constraints, generally applicable environmental standards, and associated license conditions.

(2) Each report filed pursuant to paragraph (a) of this section must include for each occupationally overexposed[12] individual: the name, Social Security account number, and date of birth. The report must be prepared so that this information is stated in a separate and detachable part of the report.

(c) For holders of an operating license for a nuclear power plant, the occurrences included in paragraph (a) of this section must be reported in accordance with the procedures described in § 50.73(b), (c), (d), (e), and (g) of this chapter and must also include the information required by paragraph (b) of this section. Occurrences reported in accordance with § 50.73 of this chapter need not be reported by a duplicate report under paragraph (a) of this section.

(d) All licensees, other than those holding an operating license for a nuclear power plant, who make reports under paragraph (a) of this section shall submit the report in writing to the U.S. Nuclear Regulatory Commission, Document Control Desk, Washington, DC 20555, with a copy to the appropriated NRC Regional Office listed in appendix D to Part 20.

§ 20.2204 Reports of planned special exposures.

The licensee shall submit a written report to the Administrator of the appropriate NRC Regional Office listed in Appendix D to Part 20 within 30 days following any planned special exposure conducted in accordance with § 20.1206, informing the Commission that a planned special exposure was conducted and indicating the date the planned special exposure occurred and the information required by § 20.2105.

§ 20.2205 Reports to individuals of exceeding dose limits.

When a licensee is required, pursuant to the provisions of §§ 20.2203, 20.2204, or 20.2206, to report to the Commission any exposure of an identified occupationally exposed individual, or an identified member of the public, to radiation or radioactive material, the licensee shall also provide a copy of the report submitted to the Commission to the individual. This report must be transmitted at a time no later than the transmittal to the Commission.

§ 20.2206 Reports of individual monitoring.

(a) This section applies to each person licensed by the Commission to—

(1) Operate a nuclear reactor designed to produce electrical or heat energy pursuant to § 50.21(b) or § 50.22 of this chapter or a testing facility as defined in § 50.2 of this chapter; or

(2) Possess or use byproduct material for purposes of radiography pursuant to Parts 30 and 34 of this chapter; or

(3) Possess or use at any one time, for purposes of fuel processing, fabricating, or reprocessing, special nuclear material in a quantity exceeding 5,000 grams of contained uranium-235, uranium-233, or plutonium, or any combination thereof pursuant to part 70 of this chapter; or

(4) Possess high-level radioactive waste at a geologic repository operations area pursuant to part 60 of this chapter; or

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[12] With respect to the limit for the embryo-fetus (§ 20.1208), the identifiers should be those of the declared pregnant woman.

(5) Possess spent fuel in an independent spent fuel storage installation (ISFSI) pursuant to part 72 of this chapter; or

(6) Receive radioactive waste from other persons for disposal under part 61 of the chapter; or

(7) Possess or use at any time, for processing or manufacturing for distribution pursuant to parts 30, 32, 33, or 35 of this chapter, byproduct material in quantities exceeding any one of the following quantities:

Radionuclide	Quantity of radionuclide[13] in curies
Cesium-137	1
Cobalt-60	1
Gold-198	100
Iodine-131	1
Iridium-192	10
Krypton-85	1,000
Promethium-147	10
Technetium-99m	1,000

(b) Each licensee in a category listed in paragraph (a) of this section shall submit an annual report of the results of individual monitoring carried out by the licensee for each individual for whom monitoring was required by § 20.1502 during that year. The licensee may include additional data for individuals for whom monitoring was provided but not required. The licensee shall use Form NRC 5 or electronic media containing all the information required by Form NRC 5.

(c) The licensee shall file the report required by § 20.2206(b), covering the preceding year, on or before April 30 of each year. the licensee shall submit the report to the REIRS Project Manager, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555.

Subpart N—Exemptions and Additional Requirements

§ 20.2301 Applications for exemptions.

The Commission may, upon application by a licensee or upon its own initiative, grant an exemption from the requirements of the regulations in this part if it determines the exemption is authorized by law and would not result in undue hazard to life or property.

§ 20.2302 Additional requirements.

The Commission may, by rule, regulation, or order, impose requirements on a licensee, in addition to those established in the regulations in this part, as it deems appropriate or necessary to protect health or to minimize danger to life or property.

[13]The Commission may require as a license condition, or by rule, regulation, or order pursuant to § 20.2302, reports from licensees who are licensed to use radionuclides not on this list, in quantities sufficient to cause comparable radiation levels.

Subpart O—Enforcement

§ 20.2401 Violations.

(a) The Commission may obtain an injunction or other court order to prevent a violation of the provisions of—

(1) The Atomic Energy Act of 1954, as amended;

(2) Title II of the Energy Reorganization Act of 1974; or

(3) A regulation or order issued pursuant to those Acts.

(b) The Commission may obtain a court order for the payment of a civil penalty imposed under section 234 of the Atomic Energy Act;

(1) For violations of—

(i) Sections 53, 57, 62, 63, 81, 82, 101, 103, 104, 107, or 109 of the Atomic Energy of 1954, as amended;

(ii) Section 206 of the Energy Reorganization Act;

(iii) Any rule, regulation, or order issued pursuant to the sections specified in paragraph (b)(1)(i) of this section;

(2) For any violation for which a license may be revoked under Section 186 of the Atomic energy Act of 1954, as amended.

§ 20.2402 Criminal penalties.

(a) Section 223 of the Atomic energy Act of 1954, as amended, provides for criminal sanction for willful violation of, attempted violation of, or conspiracy to violate, any regulation issued under sections 161b, 161i, or 161o of the Act. for purposes of section 223, all the regulations in §§ 20.1001 through 20.2402 are issued under one or more of sections 161b, 161i, or 161o, except for the sections listed in paragraph (b) of this section.

(b) The regulations in §§ 20.1001 through 20.2402 that are not issued under Sections 161b, 161i, or 161o for the purposes of Section 223 are as follows: §§ 20.1001, 20.1002, 20.1003, 20.1004, 20.1005, 20.1006, 20.1007, 20.1008, 20.1009, 20.1405, 20.1704, 20.1903, 20.1905, 20.2002, 20.2007, 20.2301, 20.2302, 20.2401, and 20.2402.

APPENDIX A TO §§ 20.1001-20.2401—PROTECTION FACTORS FOR RESPIRATORS[14]

[14]For use in the selection of respiratory protective devices to be used only where the contaminants have been identified and the concentrations (or possible concentrations) are known.

Description[16]	Protection factors[15]			Tested and certified equipment
	Modes[17]	Particulates only	Particulates, gases & vapors[18]	National Institute for Occupational Safety and Health/Mine Safety and Health Administration tests for permissibility
I. Air-purifying respirators[19]				
Facepiece, half-mask[20]	NP	10		
Facepiece, full	NP	50		30 CFR Part 11, Subpart K.
Facepiece, half-mask, full, or hood	PP	1000		
II. Atmosphere-supplying respirators				
1. Air-line Respirator				
Facepiece, half-mask	CF		1000	
Facepiece, half-mask	D		5	
Facepiece, full	CF		2000	
Facepiece, full	D		5	30 CFR Part 11, Subpart J
Facepiece, full	PD		2000	
Hood	CF		([21])	
Suit	CF		(22)	([23])
2. Self-contained breathing apparatus (SCBA)				
Facepiece, full	D		50	
Facepiece, full	PD		[24]10,000	30 CFR Part 11, Subpart M.
Facepiece, full	RD		50	
Facepiece, full	RP		[25]5,000	
III. COMBINATION RESPIRATORS				
Any combination of air-purifying and atmosphere-supplying respirators		Protection factor for type and mode of operation as listed above		30 CFR Part 11, § 11.63(b)

Note 1: Protection factors for respirators as may be approved by the U.S. Bureau of Mines/National Institute for Occupational Safety and Health (NIOSH), according to applicable approvals for respirators for type and mode of use to protect against airborne radionuclides, may be used to the extent that they do not exceed the protection factors listed in this table. The protection factors listed in this table may not be appropriate to circumstances where chemical or other respiratory hazards exist in addition to radioactive hazards. The selection and use of respirators for such circumstances should take into account applicable approvals of the U.S. Bureau of Mines/NIOSH.

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[15]1. The protection factor is a measure of the degree of protection afforded by a respirator, defined as the ratio of the concentration of airborne radioactive material outside the respiratory protective equipment to that inside the equipment (usually inside the facepiece) under conditions of use. It is applied to the ambient airborne concentration to estimate the concentrations inhaled by the wearer according to the following formula:

$$\text{Concentration inhaled} = \frac{\text{Ambient airborne concentration}}{\text{Protection factor}}$$

2. The protection factors apply:

(a) Only for individuals trained in using respirators and wearing properly fitted respirators that are used and maintained under supervision in a well-planned respiratory protective program.

(b) For air-purifying respirators only when high efficiency particulate filters (above 99.97% removal efficiency by thermally generated 0.3 μm dioctyl phthalate (DOP) test or equivalent) are used in atmospheres not deficient in oxygen and not containing radioactive gas or vapor respiratory hazards.

(c) No adjustment is to be made for the use of sorbents against radioactive material in the form of gases or vapors.

(d) For atmosphere-supplying respirators only when supplied with adequate respirable air. Respirable air shall be provided of the quality and quantity required in accordance with NIOSH/MSHA certification (described in 30 CFR Part 11). Oxygen and air shall not be used in the same apparatus.

[16]Only for shaven faces and where nothing interferes with the seal of tight-fitting facepieces against the skin (Hoods and suits are excepted.)

[17]The mode symbols are defined as follows:
CF = continuous flow
D = demand
NP = negative pressure (*i.e.*, negative phase during inhalation
PD = pressure demand (*i.e.*, always positive pressure)
PP = positive pressure
RD = demand, recirculating (closed circuit)
RP = pressure demand, recirculation (closed circuit)

[18]Excluding radioactive contaminants that present an absorption or submersion hazard. For tritium oxide, approximately one-third of the intake occurs by absorption through the skin so that an overall protection factor of less than 2 is appropriate when atmosphere-supplying respirators are used to protect against tritium oxide. If the protection factor for a device is 5, the effective protection factor for tritium is about 1.4; for devices with protection factors of 10, the effective factor for tritium oxide is about 1.7; and for devices with protection factors of 100 or more the effective factor for tritium oxide is about 1.9. Air-purifying respirators are not suitable for protection against tritium oxide. See also footnote 22 concerning supplied-air suits.

[19]Canisters and cartridges shall not be used beyond service-life limitations.

[20]Under-chin type only. This type of respirator is not satisfactory for use where it might be possible (*e.g.*, if an accident or emergency were to occur) for the ambient airborne concentrations to reach instantaneous values greater then 10 times the pertinent values in table 1, column 3 of appendix B to §§ 20.1001-2401. This type of respirator is not suitable for protection against plutonium or other high-toxicity materials. The mask is to be tested for fit prior to use, each time it is donned.

[21]1. Equipment shall be operated in a manner that ensures that proper air flow-rates are maintained. A protection factor of no more than 1000 maybe utilized for tested-and-certified supplied-air hoods when a minimum air flow of 6 cubic feet (0.17 cubic meters) per minute is maintained and calibrated airline pressure gauges or flow measuring devices are used. A protection factor of up to 2000 may be used for tested and certified hoods only when the air flow is maintained at the manufacturer's recommenced maximum rate for the equipment, this rate is greater than 6 cubic feet (0.17 cubic meters) per minute and calibrated airline pressure gauges or flow measuring devices are used.

2. The design of the supplied-air hood or helmet (with a minimum flow of 6 cfm (0.17 m^3 per minute) of air) may determine its overall efficiency and the protection it provides. For example, some hoods aspirate contaminated air into the breathing zone when the wearer works with hands-over-head. This aspiration may be overcome if a short cape-like extension to the hood is worn under a coat or overalls. Other limitations specified by the approval agency shall be considered before using a hood in certain types of atmospheres (see footnote 22).

[22]Appropriate protection factors shall be determined, taking into account the design of the suit and its permeability to the contaminant under conditions of use. There shall be a standby rescue person equipped with a respirator or other apparatus appropriate for the potential hazards and communications equipment whenever supplied-air suits are used.

Note 2: Radioactive contaminants for which the concentration values in Table 1, Column 3 of Appendix B of this part are based on internal dose due to inhalation may, in addition, present external exposure hazards at higher concentrations. Under these circumstances, limitations on occupancy may have to be governed by external dose limits.

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[23]No approval schedules are currently available for this equipment. Equipment is to be evaluated by testing or on the basis of reliable test information.

[24]This type of respirator may provide greater protection and be used as an emergency device in unknown concentrations for protection against inhalation hazards. External radiation hazards and other limitations to permitted exposure, such as skin absorption, must be taken into account in such circumstances.

[25]Quantitative fit testing shall be performed on each individual and no more than 0.02% leakage is allowed with this type of apparatus. Perceptible outward leakage of gas from this or any positive pressure self-contained breathing apparatus is unacceptable because service life will be reduce substantially. Special training in the use of this type of apparatus shall be provided to the wearer.

Appendix B to §§ 20.1001-20.2401—Annual Limits of Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Reference Level Concentrations; Concentrations for Release to Sewerage

Introduction

For each radionuclide at Table 1 indicates the chemical form which is to be used for selecting the appropriate ALI or DAC value. The ALIs and DACs for inhalation are given for an aerosol with an activity median aerodynamic diameter of 1 μm and for three classes (D, W, Y) of radioactive material, which refer to their retention (approximately days, weeks, or years) in the pulmonary region of the lung. This classification applies to a range of clearance half-times of less than 10 days for D, for W from 10 to 100 days, and for Y greater than 100 days. The class (D, W, or Y) given in the column headed "Class" applies only to the inhalation ALIs and DACs given in Table 1, columns 2 and 3.

Notation

The values in Tables 1, 2, and 3 are presented in the computer "E" notation. In this notation a value of 6E–02 represents a value of 6×10^{-2} or 0.06. 6E+2 represents 6×10^{2} or 600, and 6E+0 represents 6×10^{0} or 6.

Table 1 "Occupational"

Note that the columns in Table 1 of this appendix captioned "Oral Ingestion ALI," "Inhalation ALI," and "DAC," are applicable to occupational exposure to radioactive material.

The ALIs in this appendix are the annual intakes of given radionuclides by "Reference Man" which would result in either (1) a committed effective dose equivalent of 5 rems (stochastic ALI), or (2) a committed dose equivalent of 50 rems to an organ or tissue (non-stochastic ALI). The stochastic ALIs were derived to result in a risk, due to irradiation of organs and tissues, comparable to the risk associated with deep dose equivalent to the whole body of 5 rems. The derivation includes multiplying the committed dose equivalent to an organ or tissue by a weighting factor, w_T. This weighting factor is the proportion of the risk of stochastic effects resulting from irradiation of the organ or tissue, T, to the total risk of stochastic effects when the whole body is irradiated uniformly. The values of w_T are listed under the definition of weighting factor in § 20.1003. The non-stochastic ALIs were derived to avoid non-stochastic effects, such as prompt damage to tissue or reduction in organ function.

A value of $w_T = 0.06$ is applicable to each of the five organs or tissues in the "remainder" category receiving the highest dose equivalents, and the dose equivalents of all other remaining tissues may be disregarded. The following parts of the GI tract—stomach, small intestine, upper large intestine, and lower large intestine—are to be treated as four separate organs.

Note that the dose equivalents for extremities (hands and forearms, feet and lower legs), skin, and lens of the eye are not considered in computing the committed effective dose equivalent, but are subject to limits that must be met separately.

When an ALI is defined by the stochastic limit, this value, alone, is given. When an ALI is determined, by the non-stochastic dose limit, the organ or tissue to which the limit applies is shown, and the stochastic limit is shown in parenthesis. (Abbreviated organ or tissue

designations used are: LLI wall = lower large intestine wall; St. wall = stomach wall; Blad wall = bladder wall; and Bone surf = bone surface.)

The use of the ALIs listed first, the more limiting of the stochastic and non-stochastic ALIs, will ensure that non-stochastic effects are avoided and that the risk of stochastic effects is limited to an acceptably low value. If, in a particular situation involving a radionuclide for which the non-stochastic ALI is limiting, use of that non-stochastic ALI is considered unduly conservative, the licensee may use the stochastic ALI to determine effective dose equivalent. However, the licensee shall also ensure that the 50-rem dose equivalent limit for any organ or tissue is not exceeded by the sum of the external deep dose equivalent plus the internal committed dose to that organ (not the effective dose). For the case where there is no external dose contribution, this would be demonstrated if the sum of the fractions of the nonstochastic ALIs (ALI_{ns}) that contribute to the committed dose equivalent to the organ receiving the highest dose does not exceed unity (*i.e.*, (intake (in μCi) of each radionuclide/ALI_{ns}) < 1.0). If there is an external deep dose equivalent contribution of H_d then this sum must be less than $1 - (H_d/50)$ instead of being < 1.0.

The derived air concentration (DAC) values are derived limits intended to control chronic occupational exposures. The relationship between DAC and ALI is given by: DAC = ALI (in μCi)/(2000 hours per working year × 60 minutes/hour × 2×10^4 ml per minute) = (ALI/2.4×10^9) μCi/ml, where 2×10^4 ml is the volume of air breathed at work by "Reference Man" per minute under working conditions of "light work."

The DAC values relate to one of two modes of exposure: either external submersion or the internal committed dose equivalents resulting from inhalation of radioactive materials. Derived air concentrations based upon submersion are for immersion in a semi-infinite cloud of uniform concentration and apply to each radionuclide separately.

The ALI and DAC values relate to exposure to the single radionuclide named, but also include contributions from the ingrowth of any daughter radionuclide produced in the body by the decay of the parent. However, intakes that include both the parent and daughter radionuclides should be treated by the general method appropriate for mixtures.

The values of ALI and DAC do not apply directly when the individual both ingests and inhales a radionuclide, when the individual is exposed to a mixture of radionuclides by either inhalation or ingestion or both, or when the individual is exposed to both internal and external radiation (see § 20.1202). When an individual is exposed to radioactive materials which fall under several of the translocation classifications (*i.e.*, Class D, W, or Y) of the same radionuclide, the exposure may be treated as if it were exposure to a mixture of different radionuclides.

It should be noted that the classification of a compound as Class D, W. or Y is based on the chemical form of the compound and does not take into account the radiological half-life of different radioisotopes. for this reason, values are given for Class D, W, and Y compounds, even for very short-lived radionuclides.

Table 2

The columns in Table 2 of this appendix captioned "Effluents," "Air" and "Water," are applicable to the assessment and control of dose to the public, particularly in the implementation of the reference level provisions in § 20.1302. The concentration values given in Columns 1 and 2 of Table 2, are equivalent to the radionuclide concentrations which, if inhaled or ingested continuously over the course of a year, would produce a total effective dose equivalent of 0.05 rem (50 millirem or 0.5 millisievert).

Consideration of non-stochastic limits has not been included in deriving the air and water effluent concentration limits because non-stochastic effects are presumed not to occur at the dose levels established for individual members of the public. For radionuclides, where the non-stochastic limit was governing in deriving the occupational DAC, the stochastic ALI was used in deriving the corresponding airborne effluent limit in Table 2. for this reason, the DAC and airborne effluent limits are not always proportional as was the case in appendix B to §§ 20.1-20.601.

The air concentration values listed in Table 2, Column 1, were derived by one of two methods. For those radionuclides for which the stochastic limit is governing, the occupational stochastic inhalation ALI was divided by 2.4×10^9 ml, relating the inhalation ALI to the DAC, as explained above, and then divided by a factor of 300. The factor of 300 includes the following components: a factor of 50 to relate the 5-rem annual occupational dose limit to the 0.1-rem limit for members of the public, a factor of 3 to adjust for the difference in exposure time and the inhalation rate for a worker and that for members of the public; and a factor of 2 to adjust the occupational values (derived for adults) so that they are applicable to other age groups.

For those radionuclides for which submersion (external dose) is limiting, the occupational DAC in Table 1, Column 3, was divided by 219. The factor of 219 is composed of a factor of 50, as described above, and a factor of 4.38 relating occupational exposure for 2,000 hours per year to full-time exposure (8,760 hours per year). Note that an additional factor of 2 for age considerations is not warranted in the submersion case.

The water concentrations were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by 7.3×10^7. The factor of 7.3×10^7 (ml) includes the following components: the factors of 50 and 2 described above and a factor of 7.3×10^5 (ml) which is the annual water intake of "Reference Man."

Note 2 of this appendix provides groupings of radionuclides which are applicable to unknown mixtures of radionuclides. The groupings (including occupational inhalation ALIs and DACs, air and water effluent concentrations and sewerage) require demonstrating that the most limiting radionuclides in successive classes are absent. The limit for the unknown mixture is defined when the presence of one of the listed radionuclides cannot be definitely excluded either from knowledge of the radionuclide composition of the source or from actual measurements.

Table 3

The monthly average concentrations for release to sanitary sewers are applicable to the provisions in § 20.2003. The concentration values were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by 7.3×10^6 (ml). The factor of 7.3×10^6 (ml) is composed of 7.3×10^5 (ml), the annual water intake by "Reference Man," and a factor of 10, such that the concentrations, if the sewage released by the licensee were the only source of

water ingested by a reference man during a year, would result in a committed dose equivalent of 0.5 rem.

LIST OF ELEMENTS

Name	Atomic Symbol	Atomic No.	Name	Atomic Symbol	Atomic No.
Actinium	Ac	89	Mercury	Hg	80
Aluminum	Al	13	Molybdenum	Mo	42
Americium	Am	95	Neodymium	Nd	60
Antimony	Sb	51	Neptunium	Np	93
Argon	Ar	18	Nickel	Ni	28
Arsenic	As	33	Niobium	Nb	41
Astatine	At	85	Osmium	Os	76
Barium	Ba	56	Palladium	Pd	46
Berkelium	Bk	97	Phosphorus	P	15
Beryllium	Be	4	Platinum	Pt	78
Bismuth	Bi	83	Plutonium	Pl	94
Bromine	Br	35	Polonium	Po	84
Cadmium	Cd	48	Potassium	K	19
Calcium	Ca	20	Praseodymium	Pr	59
Californium	Cf	98	Protactinium	Pa	91
Carbon	C	6	Radium	Ra	88
Cerium	Ce	58	Radon	Rn	86
Cesium	Cs	55	Rhenium	Re	75
Chlorine	Cl	17	Rhodium	Rh	45
Chromium	Cr	24	Rubidium	Rb	37
Cobalt	Co	27	Ruthenium	Ru	44
Copper	Cu	29	Samarium	Sm	62
Curium	Cm	96	Scandium	Sc	21
Dysprosium	Dy	66	Selenium	Se	34
Einsteinium	Es	99	Silicon	Si	14
Erbium	Er	68	Silver	Ag	47
Europium	Eu	63	Sodium	Na	11
Fermium	Fm	100	Strontium	Sr	38
Fluorine	F	9	Sulfur	S	16
Francium	Fr	87	Tantalum	Ta	73
Gadolinium	Gd	64	Technetium	Tc	43
Gallium	Ga	31	Tellurium	Te	52
Germanium	Ge	32	Terbium	Tb	65
Gold	Au	79	Thallium	Tl	81
Hafnium	Hf	72	Thorium	Th	90
Holmium	Ho	67	Thulium	Tm	69
Hydrogen	H	1	Tin	Sn	50
Indium	In	49	Titanium	Ti	22
Iodine	I	53	Tungsten	W	74
Iron	Fe	26	Uranium	U	92
Krypton	Kr	36	Vanadium	V	23
Lanthanum	La	57	Xenon	Xe	54
Lead	Pb	82	Ytterbium	Yb	70
Lutetium	Lu	71	Yttrium	Y	39
Magnesium	Mg	12	Zinc	Zn	30
Manganese	Mn	25	Zirconium	Zr	40
Mendelevium	Md	101			

Atomic No.	Radionuclide	Class	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Release to Sewers
			Col. 1	Col. 2 Inhalation	Col. 3	Col. 1	Col. 2	
			Oral Ingestion ALI (µCi)	ALI (µCi)	DAC (µCi/ml)	Air (µCi/ml)	Water (µCi/ml)	Monthly Average Concentration (µCi/ml)
1	Hydrogen-1	Water, DAC includes skin absorption	8E+4	8E+4	2E–5	1E–7	1E–3	1E–2
		Gas (HT or T_2) Submersion[1]: Use above values as HT and T_2 oxidize in air and in the body to HTO.						
4	Beryllium-7	W, all compounds except those given for Y	4E+4	2E+4	9E–6	3E–8	6E–4	6E–3
		Y, oxides, halides and nitrates	—	2E+4	8E–6	3E–8	—	—
4	Beryllium-10	W, see ^{7}Be	1E+3	2E+2	6E–8	2E–10	—	—
			LLI wall (1E+3)	—	—	—	2E–5	2E–4
		Y, see ^{7}Be	—	1E+1	6E–9	2E–11	—	—
6	Carbon-11[2]	Monoxide	—	1E+6	5E–4	2E–6	—	—
		Dioxide	—	6E+5	3E–4	9E–7	—	—
		Compounds	4E+5	4E+5	2E–4	6E–7	6E–3	6E–2
6	Carbon-14	Monoxide	—	2E+6	7E–4	2E–6	—	—
		Dioxide	—	2E+5	9E–5	3E–7	—	—
		Compounds	2E+3	2E+3	1E–6	3E–9	3E–5	3E–4
9	Fluorine-18[2]	D, fluorides of H, Li, Na, K, Rb, Cs, Fr	5E+4	7E+4	3E–5	1E–7	—	—
			St. wall (5E+4)	—	—	—	7E–4	7E–3
		W, fluorides of Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, As, Sb, Bi, Fe, Ru, Os, Co, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, V, Nb, Ta, Mn, Tc, Re	—	9E+4	4E–5	1E–7	—	—
		Y, lanthanum fluoride	—	8E+4	3E–5	1E–7	—	—
11	Sodium-22	D, all compounds	4E+2	6E+2	3E–7	9E–10	6E–6	6E–5
11	Sodium-24	D, all compounds	4E+3	5E+3	2E–6	7E–9	5E–5	5E–4
12	Magnesium-28	D, all compounds except those given for W	7E+2	2E+3	7E–7	2E–9	9E–6	9E–5
		W, oxides, hydroxides, carbides, halides, and nitrates	—	1E+3	5E–7	2E–9	—	—
13	Aluminum-26	D, all compounds except those given for W	4E+2	6E+1	3E–8	9E–11	6E–6	6E–5
		W, oxides, hydroxides, carbides, halides, and nitrates	—	9E+1	4E–8	1E–10	—	—
14	Silicon-31	D, all compounds except those given for W and Y	9E+3	3E+4	1E–5	4E–8	1E–4	1E–3
		W, oxides, hydroxides, carbides, and nitrates	—	3E+4	1E–5	5E–8	—	—
		Y, aluminosilicate glass	—	3E+4	1E–5	4E–8	—	—
14	Silicon-32	D, see ^{31}Si	2E+3	2E+2	1E–7	3E–10	—	—
			LLI wall (3E+3)	—	—	—	4E–5	4E–4
		W, see ^{31}Si	—	1E+2	5E–8	2E–10	—	—
		Y, see ^{31}Si	—	5E+0	2E–9	7E–12	—	—
15	Phosphorus-32	D, all compounds except phosphates given for W	6E+2	9E+2	4E–7	1E–9	9E–6	9E–5
		W, phosphates of Zn^{2+}, S^{3+}, Mg^{2+}, Fe^{3+}, Bi^{3+}, and lanthanides	—	4E+2	2E–7	5E–10	—	—
15	Phosphorus-33	D, see ^{32}P	6E+3	8E+3	4E–6	1E–8	8E–5	8E–4
		W, see ^{32}P	—	3E+3	1E–6	4E–9	—	—
16	Sulfur-35	Vapor	—	1E+4	6E–6	2E–8	—	—
		D, sulfides and sulfates except those given for W	1E+4	2E+4	7E–6	2E–8	—	—
			LLI wall 8E+3	—	—	—	1E–4	1E–3
		W, elemental sulfur, sulfides of Sr, Ba, Ge, Sn, Pb, As, Sb, Bi, Cu, Ag, Au, Zn, Cd, Hg, W, Mo. Sulfates of Ca, Sr, Ba, Ra, As, Sb, Bi	—	2E+3	9E–7	3E–9	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
17	Chlorine-36	D, Chlorides of H, Li, Na, K, Rb, Cs, Fr	2E+3	2E+3	1E–6	3E–9	2E–5	2E–4
		W, chlorides of lanthanides, Be, Mg, Ca, S, Ba, Ra, Al, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Tc, and Re	—	2E+2	1E–7	3E–10	—	—
17	Chlorine-38[2]	D, see ^{36}Cl	2E+4	4E+4	2E–5	6E–8	—	—
			St. wall (3E+4)	—	—	—	3E–4	3E–3
		W, see ^{36}Cl	—	5E+4	2E–5	6E–8	—	—
17	Chlorine-39[2]	D see ^{36}Cl	2E+4	5E+4	2E–5	7E–8	—	—
			St. wall (4E+4)	—	—	—	5E–4	5E–3
		W, see ^{36}Cl	—	6E+4	2E–5	8E–8	—	—
18	Argon-37	Submersion[1]	—	—	1E+0	6E–3	—	—
18	Argon-39	Submersion[1]	—	—	2E–4	8E–7	—	—
18	Argon-41	Submersion[1]	—	—	3E–6	1E–8	—	—
19	Potassium-40	D, all compounds	3E+2	4E+4	2E–7	6E–10	4E–6	4E–5
19	Potassium-42	D, al compounds	5E+3	5E+3	2E–6	7E–9	6E–5	6E–4
19	Potassium-43	D, all compounds	6E+3	9E+3	4E–6	1E–8	9E–5	9E–4
19	Potassium-44[2]	D, all compounds	2E+4	7E+4	3E–5	9E–8	—	—
			St. Wall (4E+4)	—	—	—	5E–4	5E–3
19	Potassium-45[2]	D, all compounds	3E+4	1E+5	5E–5	2E–7	—	—
			St. Wall (5E+4)	—	—	—	7E–4	7E–3
20	Calcium-41	W, all compounds	3E+3	4E+3	2E–6	—	—	—
			Bone surf (4E+3)	Bone surf (4E+3)	—	5E–9	6E–5	6E–4
20	Calcium-45	W all compounds	2E+3	8E+2	4E–7	1E–9	2E–5	2E–4
20	Calcium-47	W, all compounds	8E+2	9E+2	4E–7	1E–9	1E–5	1E–4
21	Scandium-43	Y, all compounds	7E+3	2E+4	9E–6	3E–8	1E–4	1E–3
21	Scandium-44m	Y, all compounds	5E+2	7E+2	3E–7	1E–9	7E–6	7E–5
21	Scandium-44	Y, all compounds	4E+3	1E+4	5E–6	2E–8	5E–5	5E–4
21	Scandium-46	Y, all compounds	9E+2	2E+2	1E–7	3E–10	1E–5	1E–4
21	Scandium-47	Y, all compounds	2E+3	3E+3	1E–6	4E–9	—	—
			LLI wall (3E+3)	—	—	—	4E–5	4E–4
21	Scandium-48	Y, all compounds	8E+2	1E+3	6E–7	2E–9	1E–5	1E–4
21	Scandium-49[2]	Y, all compounds	2E+4	5E+4	2E–5	8E–8	3E–4	3E–3
22	Titanium-44	D, all compounds except those given for W and Y	3E+2	1E+1	5E–9	2E–11	4E–6	4E–5
		W, oxides, hydroxides, carbides, halides, and nitrates	—	3E+1	1E–8	4E–11	—	—
		Y, $SrTiO_3$	—	6E+0	2E–9	8E–12	—	—
22	Titanium-45	D, see ^{44}Ti	9E+3	3E+4	1E–5	3E–8	1E–4	1E–3
		W, see ^{44}Ti	—	4E+4	1E–5	5E–8	—	—
		Y, see ^{44}Ti	—	3E+4	1E–5	4E–8	—	—
23	Vanadium-47[2]	D, all compounds except those given for W	3E+4	8E+4	3E–5	1E–7	—	—
			St. wall (3E+4)	—	—	—	4E–4	4E–3
		W, oxides, hydroxides, carbides, and halides	—	1E+5	4E–5	1E–7	—	—
23	Vanadium-48	D, see ^{47}V	6E+2	1E+3	5E–7	2E–9	9E–6	9E–6
		W, see ^{47}V	—	6E+2	3E–7	9E–10	—	—
23	Vanadium-49	D, see ^{47}V	7E+4	3E+4	1E–5	—	—	—
			LLI Wall (9E+4)	Bone surf (3E+4)	—	5E–8	1E–3	1E–2
		W, see ^{47}V	—	2E+4	8E–6	2E–8	—	—
24	Chromium-48	D, all compounds except those given for Wand Y	6E+3	1E+4	5E–6	2E–8	8E–5	8E–4
		W, halides and nitrates	—	7E+3	3E–6	1E–8	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
		Y, oxides and hydroxides	—	7E+3	3E–6	1E–8	—	—
24	Chromium-49[2]	D, see ^{48}Cr	3E+4	8E+4	4E–5	1E–7	4E–4	4E–3
		W, see ^{48}Cr	—	1E+5	4E–5	1E–7	—	—
		Y, see ^{48}Cr	—	9E+4	4E–5	1E–7	—	—
24	Chromium-51	D, see ^{48}Cr	4E+4	5E+4	2E–5	6E–8	5E–4	5E–3
		W, see ^{48}Cr	—	2E+4	1E–5	3E–8	—	—
		Y, see ^{48}Cr	—	2E+4	8E–6	3E–8	—	—
25	Manganese-51[2]	D, all compounds except those given for W	2E+4	5E+4	2E–5	7E–8	3E–4	3E–3
		W, oxides, hydroxides, halides, and nitrates	—	6E+4	3E–5	8E–8	—	—
25	Manganese-52m[2]	D, see ^{51}Mn	3E+4	9E+4	4E–5	1E–7	—	—
			St. wall (4E+4)	—	—	—	5E–4	5E–3
		W, see ^{51}Mn	—	1E+5	4E–5	1E–7	—	—
25	Manganese-52	D, see ^{51}Mn	7E+2	1E+3	5E–7	2E–9	1E–5	1E–4
		W, see ^{51}Mn	—	9E+2	4E–7	1E–9	—	—
25	Manganese-53	D, see ^{51}Mn	5E+4	1E+4	5E–6	—	7E–4	7E–3
			—	Bone surf. (2E+4)	—	3E–8	—	—
		W, see ^{51}Mn	—	1E+4	5E–6	2E–8	—	—
25	Manganese-54	D, see ^{51}Mn	2E+3	9E+2	4E–7	1E–9	3E–5	3E–4
		W, see ^{51}Mn	—	8E+2	3E–7	1E–9	—	—
25	Manganese-56	D, see ^{51}Mn	5E+3	2E+4	6E–6	2E–8	7E–5	7E–4
		W, see ^{51}Mn	—	2E+4	9E–6	3E–8	—	—
26	Iron-52	D, all compounds except those given for W	9E+2	3E+3	1E–6	4E–9	1E–5	1E–4
		W, oxides, hydroxides, and halides	—	2E+3	1E–6	3E–9	—	—
26	Iron-55	D, see ^{52}Fe	9E+3	2E+3	8E–7	3E–9	1E–4	1E–3
		W, see ^{52}Fe	—	4E+3	2E–6	6E–9	—	—
26	Iron-59	D, see ^{52}Fe	8E+2	3E+2	1E–7	5E–10	1E–5	1E–4
		W, see ^{52}Fe	—	5E+2	2E–7	7E–10	—	—
26	Iron-60	D, see ^{52}Fe	3E+1	6E+0	3E–9	9E–12	4E–7	4E–6
		W, see ^{52}Fe	—	2E+1	8E–9	3E–11	—	—
27	Cobalt-55	W, all compounds except those given for Y	1E+3	3E+3	1E–6	4E–9	2E–5	2E–4
		Y, oxides, hydroxides, halides and nitrates	—	3E+3	1E–6	4E–9	—	—
27	Cobalt-56	W, see ^{55}Co	5E+2	3E+2	1E–7	4E–10	6E–6	6E–5
		Y, see ^{55}Co	4E+2	2E+2	8E–8	3E–10	—	—
27	Cobalt-57	W, see ^{55}Co	8E+3	3E+3	1E–6	4E–9	6E–5	6E–4
		Y, see ^{55}Co	4E+3	7E+2	3E–7	9E–10	—	—
27	Cobalt-58m	W, see ^{55}Co	6E+4	9E+4	4E–5	1E–7	8E–4	8E–3
		Y, see ^{55}Co	—	6E+4	3E–5	9E–8	—	—
27	Cobalt-58	W, see ^{55}Co	2E+3	1E+3	5E–7	2E–9	2E–5	2E–4
		Y, see ^{55}Co	1E+3	7E+2	3E–7	1E–9	—	—
27	Cobalt-60m[2]	W, see ^{55}Co	1E+6	4E+6	2E–3	6E–6	—	—
			St. wall (1E+6)	—	—	—	2E–2	2E–1
		Y, see ^{55}Co	—	3E+6	1E–3	4E–6	—	—
27	Cobalt-60	W, see ^{55}Co	5E+2	2E+2	7E–8	2E–10	3E–6	3E–5
		Y, see ^{55}Co	2E+2	3E+1	1E–8	5E–11	—	—
27	Cobalt-61[2]	W, see ^{55}Co	2E+4	6E+4	3E–5	9E–8	3E–4	3E–3
		Y, see ^{55}Co	2E+4	6E+4	2E–5	8E–8	—	—
27	Cobalt-62m[2]	W, see ^{55}Co	4E+4	2E+5	7E–5	2E–7	—	—
			St. wall (5E+4)	—	—	—	7E–4	7E–3
		Y, see ^{55}Co	—	2E+5	6E–5	2E–7	—	—
28	Nickel-56	D, all compounds except those given for W	1E+3	2E+3	8E–7	3E–9	2E–5	2E–4
		W, oxides, hydroxides, and carbides	—	1E+3	5E–7	2E–9	—	—
		Vapor	—	1E+3	5E–7	2E–9	—	—
28	Nickel-57	D, see ^{56}Ni	2E+3	5E+3	2E–6	7E–9	2E–5	2E–4
		W, see ^{56}Ni	—	3E+3	1E–6	4E–9	—	—
		Vapor	—	6E+3	3E–6	9E–9	—	—
28	Nickel-59	D, see ^{56}Ni	2E+4	4E+3	2E–6	5E–9	3E–4	3E–3

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
		W, see ^{56}Ni	—	7E+3	3E–6	1E–8	—	—
		Vapor	—	2E+3	8E–7	3E–9	—	—
28	Nickel-63	D, see ^{56}Ni	9E+3	2E+3	7E–7	2E–9	1E–4	1E–3
		W, see ^{56}Ni	—	3E+3	1E–6	4E–9	—	—
		Vapor	—	8E+2	3E–7	1E–9	—	—
28	Nickel-65	D, see ^{56}Ni	8E+3	2E+4	1E–5	3E–8	1E–4	1E–3
		W, see ^{56}Ni	—	3E+4	1E–5	4E–8	—	—
		Vapor	—	2E+4	7E–6	2E–8	—	—
28	Nickel-66	D, see ^{56}Ni	4E+2	2E+3	7E–7	2E–9	—	—
			LLI wall (5E+2)	—	—	—	6E–6	6E–5
		W, see ^{56}Ni	—	6E+2	3E–7	9E–10	—	—
		Vapor	—	3E+3	1E–6	4E–9	—	—
29	Copper-60[2]	D, all compounds except those given for W and Y	3E+4	9E+4	4E–5	1E–7	—	—
			St. wall (3E+4)	—	—	—	4E–4	4E–3
		W, sulfides, halides, and nitrates	—	1E+5	5E–5	2E–7	—	—
		Y, oxides and hydroxides	—	1E+5	4E–5	1E–7	—	—
29	Copper-61	D, see ^{60}Cu	1E+4	3E+4	1E–5	4E–8	2E–4	2E–3
		W, see ^{60}Cu	—	4E+4	2E–5	6E–8	—	—
		Y, see ^{60}Cu	—	4E+4	1E–5	5E–8	—	—
29	Copper-64	D, see ^{60}Cu	1E+4	3E+4	1E–5	4E–8	2E–4	2E–3
		W, see ^{60}Cu	—	2E+4	1E–5	3E–8	—	—
		Y see ^{60}Cu	—	2E+4	9E–6	3E–8	—	—
29	Copper-67	D, see ^{60}Cu	5E+3	8E+3	3E–6	1E–8	6E–5	6E–4
		W, see ^{60}Cu	—	5E+3	2E–6	7E–9	—	—
		Y see ^{60}Cu	—	5E+3	2E–6	6E–9	—	—
30	Zinc-62	Y, all compounds	1E+3	3E+3	1E–6	4E–9	2E–5	2E–4
30	Zinc-63[2]	Y, all compounds	2E+4	7E+4	3E–5	9E–8	—	—
			St. wall (3E+4)	—	—	—	3E–4	3E–3
30	Zinc-65	Y, all compounds	4E+2	3E+2	1E–7	4E–10	5E–6	5E–5
30	Zinc-69m	Y, all compounds	4E+3	7E+3	3E–6	1E–8	6E–5	6E–4
30	Zinc-69[2]	Y, all compounds	6E+4	1E+5	6E–5	2E–7	8E–4	8E–3
30	Zinc-71m	Y, all compounds	6E+3	2E+4	7E–6	2E–8	8E–5	8E–4
30	Zinc-72	Y, all compounds	1E+3	1E+3	5E–7	2E–9	1E–5	1E–4
31	Gallium-65[2]	D, all compounds except those given for W	5E+4	2E+5	7E–5	2E–7	—	—
			St. wall (6E+4)	—	—	—	9E–4	9E–3
		W, oxides, hydroxides, carbides, halides, and nitrates	—	2E+5	8E–5	3E–7	—	—
31	Gallium-66	D, see ^{65}Ga	1E+3	4E+3	1E–6	5E–9	1E–5	1E–4
		W, see ^{65}Ga	—	3E+3	1E–6	4E–9	—	—
31	Gallium-67	D, see ^{65}Ga	7E+3	1E+4	6E–6	2E–8	1E–4	1E–3
		W, see ^{65}Ga	—	1E+4	4E–6	1E–8	—	—
31	Gallium-68[2]	D, see ^{65}Ga	2E+4	4E+4	2E–5	6E–8	2E–4	2E–3
		W, see ^{65}Ga	—	5E+4	2E–5	7E–8	—	—
31	Gallium-70[2]	D, see ^{65}Ga	5E+4	2E+5	7E–5	2E–7	—	—
			St. wall (7E+4)	—	—	—	1E–3	1E–2
		W, see ^{65}Ga	—	2E+5	8E–5	3E–7	—	—
31	Gallium-72	D, see ^{65}Ga	1E+3	4E+3	1E–6	5E–9	2E–5	2E–4
		W, see ^{65}Ga	—	3E+3	1E–6	4E–9	—	—
31	Gallium-73	D, see ^{65}Ga	5E+3	2E+4	6E–6	2E–8	—	—
		W, see ^{65}Ga	—	2E+4	6E–6	2E–8	—	—
32	Germanium-66	D, all compounds except those given for W	2E+4	3E+4	1E–5	4E–8	3E–4	3E–3
		W, oxides, sulfides, and halides	—	2E+4	8E–6	3E–8	—	—
32	Germanium-67[2]	D, see ^{66}Ge	3E+4	9E+4	4E–5	1E–7	—	—
			St. wall (4E+4)	—	—	—	6E–4	6E–3
		W, see ^{66}Ge	—	1E+5	4E–5	1E–7	—	—
32	Germanium-68	D, see ^{66}Ge	5E+3	4E+3	2E–6	5E–9	6E–5	6E–4

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
		W, see ^{66}Ge	—	1E+2	4E–8	1E–10	—	—
32	Germanium-69	D, see ^{66}Ge	1E+4	2E+4	6E–6	2E–8	2E–4	2E–3
		W, see ^{66}Ge	—	8E+3	3E–6	1E–8	—	—
32	Germanium-71	D, see ^{66}Ge	5E+5	4E+5	2E–4	6E–7	7E–3	7E–2
		W, see ^{66}Ge	—	4E+4	2E–5	6E–8	—	—
32	Germanium-75[2]	D, see ^{66}Ge	4E+4	8E+4	3E–5	1E–7	—	—
			St. wall (7E+4)	—	—	—	9E–4	9E–3
		W, see ^{66}Ge	—	8E+4	4E–5	1E–7	—	—
32	Germanium-77	D, see ^{66}Ge	9E+3	1E+4	4E–6	1E–8	1E–4	1E–3
		W, see ^{66}Ge	—	6E+3	2E–6	8E–9	—	—
32	Germanium-78[2]	D, see ^{66}Ge	2E+4	2E+4	9E–6	3E–8	—	—
			St. wall (2E+4)	—	—	—	3E–4	3E–3
		W, see ^{66}Ge	—	2E+4	9E–6	3E–8	—	—
33	Arsenic-69[2]	W, all compounds	3E+4	1E+5	5E–5	2E–7	—	—
			St. wall (4E+4)	—	—	—	6E–4	6E–3
33	Arsenic-72[2]	W, all compounds	1E+4	5E+4	2E–5	7E–8	2E–4	2E–3
33	Arsenic-71	W, all compounds	4E+3	5E+3	2E–6	6E–9	5E–5	5E–4
33	Arsenic-72	W, all compounds	9E+2	1E+3	6E–7	2E–9	1E–5	1E–4
33	Arsenic-73	W, all compounds	8E+3	2E+3	7E–7	2E–9	1E–4	1E–3
33	Arsenic-74	W, all compounds	1E+3	8E+2	3E–7	1E–9	2E–5	2E–4
33	Arsenic-76	W, all compounds	1E+3	1E+3	6E–7	2E–9	1E–5	1E–4
33	Arsenic-77	W, all compounds	4E+3	5E+3	2E–9	7E–9	—	—
			LLI wall (5E+3)	—	—	—	6E–5	6E–4
33	Arsenic-78[2]	W, all compounds	8E+3	2E+4	9E–6	3E–8	1E–4	1E–3
34	Selenium-70[2]	D, all compounds except those given for W	2E+4	4E+4	2E–5	5E–8	1E–4	1E–3
		W, oxides, hydroxides, carbides, and elemental Se	1E+4	4E+4	2E–5	6E–8	—	—
34	Selenium-73m[2]	D, see ^{70}Se	6E+4	2E+5	6E–5	2E–7	4E–4	4E–3
		W, see ^{70}Se	3E+4	1E+5	6E–5	2E–7	—	—
34	Selenium-73	D, see ^{70}Se	3E+3	1E+4	5E–6	2E–8	4E–5	4E–4
		W, see ^{70}Se	—	2E+4	7E–6	2E–8	—	—
34	Selenium-75	D, see ^{70}Se	5E+2	7E+2	3E–7	1E–9	7E–6	7E–5
		W, see ^{70}Se	—	6E+2	3E–7	8E-10	—	—
34	Selenium-79	D, see ^{70}Se	6E+2	8E+2	3E–7	1E–9	8E–6	8E–5
		W, see ^{70}Se	—	6E+2	2E–7	8E–10	—	—
34	Selenium-81m[2]	D, see ^{70}Se	4E+4	7E+4	3E–5	9E–8	3E–4	3E–3
		W, see ^{70}Se	2E+4	7E+4	3E–5	1E–7	—	—
34	Selenium-81[2]	D, see ^{70}Se	6E+4	2E+5	9E–5	3E–7	—	—
			St. wall (8E+4)	—	—	—	1E–3	1E–2
		W, see ^{70}Se	—	2E+5	1E–4	3E–7	—	—
34	Selenium-83[2]	D, see ^{70}Se	4E+4	1E+5	5E–5	2E–7	4E–4	4E–3
		W, see ^{70}Se	3E+4	1E+5	5E–5	2E–7	—	—
35	Bromine-74m[2]	D, bromides of H, Li, Na, K, Rb, Cs, and Fr	1E+4	4E+4	2E–5	5E–8	—	—
			St. wall (2E+4)	—	—	—	3E–4	3E–3
		W, bromides of lanthanides, Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, Hf, V, Nb, Ta, Mn, Tc, and Re	—	4E+4	2E–5	6E–8	—	—
35	Bromine-74[2]	D, see ^{74m}Br	2E+4	7E+4	3E–5	1E–7	—	—
			St. wall (4E+4)	—	—	—	5E–4	5E–3
		W, see ^{74m}Br	—	8E+4	4E–5	1E–7	—	—
35	Bromine-75[2]	D, see ^{74m}Br	3E+4	5E+4	2E–5	7E–8	—	—
			St. wall (4E+4)	—	—	—	5E–4	5E–3
		W, see ^{74m}Br	—	5E+4	2E–5	7E–8	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
35	Bromine-76	D, see ^{74m}Br	4E+3	5E+3	2E–6	7E–9	5E–5	5E–4
		W, see ^{74m}Br	—	4E+3	2E–6	6E–9	—	—
35	Bromine-77	D, see ^{74m}Br	2E+4	2E+4	1E–5	3E–8	2E–4	2E–3
		W, see ^{74m}Br	—	2E+4	8E–6	3E–8	—	—
35	Bromine-80m	D, see ^{74m}Br	2E+4	2E+4	7E–6	2E–8	3E–4	3E–3
		W, see ^{74m}Br	—	1E+4	6E–6	2E–8	—	—
35	Bromine-80[2]	D, see ^{74m}Br	5E+4	2E+5	8E–5	3E–7	—	—
			St. wall (9E+4)	—	—	—	1E–3	1E–2
		W, see ^{74m}Br	—	2E+5	9E–5	3E–7	—	—
35	Bromine-82	D, see ^{74m}Br	3E+3	4E+3	2E–6	6E–9	4E–5	4E–4
		W, see ^{74m}Br	—	4E+3	2E–6	5E–9	—	—
35	Bromine-83	D, see ^{74m}Br	5E+4	6E+4	3E–5	9E–8	—	—
			St. wall (7E+4)	—	—	—	9E–4	9E–3
		W, see ^{74m}Br	—	6E+4	3E–5	9E–8	—	—
35	Bromine-84[2]	D, see ^{74m}Br	2E+4	6E+4	2E–5	8E–8	—	—
			St. wall (3E+4)	—	—	—	4E–4	4E–3
		W, see ^{74m}Br	—	6E+4	3E–5	9E–8	—	—
36	Krypton-74[2]	Submersion[1]	—	—	3E–6	1E–8	—	—
36	Krypton-76	Submersion[1]	—	—	9E–6	4E–8	—	—
36	Krypton-77[2]	Submersion[1]	—	—	4E–6	2E–8	—	—
36	Krypton-79	Submersion[1]	—	—	2E–5	7E–8	—	—
36	Krypton-81	Submersion[1]	—	—	7E–4	3E–6	—	—
36	Krypton-83m[2]	Submersion[1]	—	—	1E–2	5E–5	—	—
36	Krypton-85m	Submersion[1]	—	—	2E–5	1E–7	—	—
36	Krypton-85	Submersion[1]	—	—	1E–4	7E–7	—	—
36	Krypton-87[2]	Submersion[1]	—	—	5E–6	2E–8	—	—
36	Krypton-88	Submersion[1]	—	—	2E–6	9E–9	—	—
37	Rubidium-79[2]	D, all compounds	4E+4	1E+5	5E–5	2E–7	—	—
			St. wall (6E+4)	—	—	—	8E–4	8E–3
37	Rubidium-81m[2]	D, all compounds	2E+5	3E+5	1E–4	5E–7	—	—
			St. wall (3E+5)	—	—	—	4E–3	4E–2
37	Rubidium-81	D, all compounds	4E+4	5E+4	2E–5	7E–8	5E–4	5E–3
37	Rubidium-82m	D, all compounds	1E+4	2E+4	7E–6	2E–8	2E–4	2E–3
37	Rubidium-83	D, all compounds	6E+2	1E+3	4E–7	1E–9	9E–6	9E–5
37	Rubidium-84	D, all compounds	5E+2	8E+2	3E–7	1E–9	7E–6	7E–5
37	Rubidium-86	D, all compounds	5E+2	8E+2	3E–7	1E–9	7E–6	7E–5
37	Rubidium-87	D, all compounds	1E+3	2E+3	6E–7	2E–9	1E–5	1E–4
37	Rubidium-88[2]	D, all compounds	2E+4	6E+4	3E–5	9E–8	—	—
			St. wall (3E+4)	—	—	—	4E–4	4E–3
37	Rubidium-89[2]	D, all compounds	4E+4	1E+5	6E–5	2E–7	—	—
			St. wall (6E+4)	—	—	—	9E–4	9E–3
38	Strontium-80[2]	D, all soluble compounds except $SrTiO_3$	4E+3	1E+4	5E–6	2E–8	6E–5	6E–4
		Y, all insoluble compounds and $SrTiO_3$	—	1E+4	5E–6	2E–8	—	—
38	Strontium-81[2]	D, see ^{80}Sr	3E+4	8E+4	3E–5	1E–7	3E–4	3E–3
		Y, see ^{80}Sr	2E+4	8E+4	3E–5	1E–7	—	—
38	Strontium-82	D, see ^{80}Sr	3E+2	4E+2	2E–7	6E–10	—	—
			LLI wall (2E+2)	—	—	—	3E–6	3E–5
		Y, see ^{80}Sr	2E+2	9E+1	4E–8	1E–10	—	—
38	Strontium-83	D, see ^{80}Sr	3E+3	7E+3	3E–6	1E–8	3E–5	3E–4
		Y, see ^{80}Sr	2E+3	4E+3	1E–6	5E–9	—	—
38	Strontium-85m[2]	D, see ^{80}Sr	2E+5	6E+5	3E–4	9E–7	3E–3	3E–2
		Y, see ^{80}Sr	—	8E+5	4E–4	1E–6	—	—
38	Strontium-85	D, see ^{80}Sr	3E+3	3E+3	1E–6	4E–9	4E–5	4E–4
		Y, see ^{80}Sr	—	2E+3	6E–	2E–9	—	—
38	Strontium-87m	D, see ^{80}Sr	5E+4	1E+5	5E–65	2E–7	6E–4	6E–3
		Y, see ^{80}Sr	4E+4	2E+5	6E–5	2E–7	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
40	Zirconium-86	D, all compounds except those given for W and Y	1E+3	4E+3	2E–6	6E–9	2E–5	2E–4
		W, oxides, hydroxides, halides, and nitrates	—	3E+3	1E–6	4E–9	—	—
		Y, carbide	—	2E+3	1E–6	3E–9	—	—
40	Zirconium-88	D, see ^{86}Zr	4E+3	2E+2	9E–8	3E–10	5E–5	5E–4
		W, see ^{86}Zr	—	5E+2	2E–7	7E–10	—	—
		Y, see ^{86}Zr	—	3E+2	1E–7	4E–10	—	—
40	Zirconium-89	D, see ^{86}Zr	2E+3	4E+3	1E–6	5E–9	2E–5	2E–4
		W, see ^{86}Zr	—	2E+3	1E–6	3E–9	—	—
		Y, see ^{86}Zr	—	2E+3	1E–6	3E–9	—	—
40	Zirconium-93	D, see ^{86}Zr	1E+3	6E+0	3E–9	—	—	—
			Bone surf (3E+3)	Bone surf (2E+1)	—	2E–11	4E–5	4E–4
		W, see ^{86}Zr	—	2E+1	1E–8	—	—	—
			—	Bone surf (6E+1)	—	9E–11	—	—
		Y, see ^{86}Zr	—	6E+1	2E–8	—	—	—
			—	Bone surf (7E+1)	—	9E–11	—	—
40	Zirconium-95	D, see ^{86}Zr	1E+3	1E+2	5E–8	—	2E–5	2E–4
			—	Bone surf (3E+2)	—	4E–10	—	—
		W, see ^{86}Zr	—	4E+2	2E–7	5E–10	—	—
		Y, see ^{86}Zr	—	3E+2	1E–7	4E–10	—	—
40	Zirconium-97	D, see ^{86}Zr	6E+2	2E+3	8E–7	3E–9	9E–6	9E–5
		W, see ^{86}Zr	—	1E+3	6E–7	2E–9	—	—
		Y, see ^{86}Zr	—	1E+3	5E–7	2E–9	—	—
41	Niobium-98[2]	W, all compounds except those given for Y	5E+4	2E+5	9E–5	3E–7	—	—
			St. wall (7E+4)	—	—	—	1E–3	1E–2
		Y, oxides and hydroxides	—	2E+5	9E–5	3E–7	—	—
41	Niobium-89m[2] (66 min)	W, see ^{88}Nb	1E+4	4E+4	2E–5	6E–8	1E–4	1E–3
		Y, see ^{88}Nb	—	4E+4	2E–5	5E–8	—	—
41	Niobium-89 (122 min)	W, see ^{88}Nb	5E+3	2E+4	8E–6	3E–8	7E–5	7E–4
		Y, see ^{88}Nb	—	2E+4	6E–6	2E–8	—	—
41	Niobium-90	W, see ^{88}Nb	1E+3	3E+3	1E–6	4E–9	1E–5	1E–4
		Y, see ^{88}Nb	—	2E+3	1E–6	3E–9	—	—
41	Niobium-93m	W, see ^{88}Nb	9E+3	2E+3	8E–7	3E–9	—	—
			LLI wall (1E+4)	—	—	—	2E–4	2E–3
		Y, see ^{88}Nb	—	2E+2	7E–8	2E–10	—	—
41	Niobium-94	W, see ^{88}Nb	9E+2	2E+2	8E–8	3E–10	1E–5	1E–4
		Y, see ^{88}Nb	—	2E+1	6E–9	2E–11	—	—
41	Niobium-95m	W, see ^{88}Nb	2E+3	3E+3	1E–6	4E–9	—	—
			LLI wall (2E+3)	—	—	—	3E–5	3E–4
		Y, see ^{88}Nb	—	2E+3	9E–7	3E–9	—	—
41	Niobium-95	W, see ^{88}Nb	2E+3	1E+3	5E–7	2E–9	3E–5	3E–4
		Y, see ^{88}Nb	—	1E+3	5E–7	2E–9	—	—
41	Niobium-96	W, see ^{88}Nb	1E+3	3E+3	1E–6	4E–9	2E–5	2E–4
		Y, see ^{88}Nb	—	2E+3	1E–6	3E–9	—	—
41	Niobium-97[2]	W, see ^{88}Nb	2E+4	8E+4	3E–5	1E–7	3E–4	3E–3
		Y, see ^{88}Nb	—	7E+4	3E–5	1E–7	—	—
41	Niobium-98[2]	W, see ^{88}Nb	1E+4	5E+4	2E–5	8E–8	2E–4	2E–3
		Y, see ^{88}Nb	—	5E+4	2E–5	7E–8	—	—
42	Molybdenum-90	D, all compounds except those given for Y	4E+3	7E+3	3E–6	1E–8	3E–5	3E–4
		Y, oxides, hydroxides, and MoS_2	2E+3	5E+3	2E–6	6E–9	—	—
42	Molybdenum-93m	D, see ^{90}Mo	9E+3	2E+4	7E–6	2E–8	6E–5	6E–4
		Y, see ^{90}Mo	4E+3	1E+4	6E–6	2E–8	—	—
42	Molybdenum-93	D, see ^{90}Mo	4E+3	5E+3	2E–6	8E–9	5E–5	5E–4
		Y, see ^{90}Mo	2E+4	2E+2	8E–8	2E–10	—	—
42	Molybdenum-99	D, see ^{90}Mo	2E+3	3E+3	1E–6	4E–9	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
			LLI wall (3E+3)	—	—	—	2E–5	2E–4
		Y, see ^{90}Mo	1E+3	1E+3	6E–7	2E–9	—	—
42	Molybdenum-101[2]	D, see ^{90}Mo	4E+4	1E+5	6E–5	2E–7	—	—
			St. wall (5E+4)	—	—	—	7E–4	7E–3
		Y, see ^{90}Mo	—	1E+5	6E–5	2E–7	—	—
43	Technetium-93m[2]	D, all compounds except those given for W	7E+4	2E+5	6E–5	2E–7	1E–3	1E–2
		W, oxides, hydroxides, halides, and nitrates	—	3E+5	1E–4	4E–7	—	—
43	Technetium-93	D, see ^{93m}Tc	3E+4	7E+4	3E–5	1E–7	4E–4	4E–3
		W, see ^{93m}Tc	—	1E+5	4E–5	1E–7	—	—
43	Technetium-94m[2]	D, see ^{93m}Tc	2E+4	4E+4	2E–5	6E–8	3E–4	3E–3
		W, see ^{93m}Tc	—	6E+4	2E–5	8E–8	—	—
43	Technetium-94	D, see ^{93m}Tc	9E+3	2E+4	8E–6	3E–8	1E–4	1E–3
		W, see ^{93m}Tc	—	2E+4	1E–5	3E–8	—	—
43	Technetium-95m	D, see ^{93m}Tc	4E+3	5E+3	2E–6	8E–9	5E–5	5E–4
		W, see ^{93m}Tc	—	2E+3	8E–7	3E–9	—	—
43	Technetium-95	D, see ^{93m}Tc	1E+4	2E+4	9E–6	3E–8	1E–4	1E–3
		W, see ^{93m}Tc	—	2E+4	8E–6	3E–8	—	—
43	Technetium-96m[2]	D, see ^{93m}Tc	2E+5	3E+5	1E–4	4E–7	2E–3	2E–2
		W, see ^{93m}Tc	—	2E+5	1E–4	3E–7	—	—
43	Technetium-96	D, see ^{93m}Tc	2E+3	3E+3	1E–6	5E–9	3E–5	3E–4
		W, see ^{93m}Tc	—	2E+3	9E–7	3E–9	—	—
43	Technetium-97m	D, see ^{93m}Tc	5E+3	7E+3	3E–6	—	6E–5	6E–4
			—	St. wall (7E+3)	—	1E–8	—	—
		W, see ^{93m}Tc	—	1E+3	5E–7	2E–9	—	—
43	Technetium-97	D, see ^{93m}Tc	4E+4	5E+4	2E–5	7E–8	5E–4	5E–3
		W, see ^{93m}Tc	—	6E+3	2E–6	8E–9	—	—
43	Technetium-98	D, see ^{93m}Tc	1E+3	2E+3	7E–7	2E–9	1E–5	1E–4
		W, see ^{93m}Tc	—	3E+2	1E–7	4E–10	—	—
43	Technetium-99m	D, see ^{93m}Tc	8E+4	2E+5	6E–5	2e–7	1E–3	1E–2
		W, see ^{93m}Tc	—	2E+5	1E–4	3E–7	—	—
43	Technetium-99	D, see ^{93m}Tc	4E+3	5E+3	2E–6	—	6E–5	6E–4
			—	St. wall (6E+3)	—	8E–9	—	—
		W, see ^{93m}Tc	—	7E+2	3E–7	9E–10	—	—
43	Technetium-101[2]	D, see ^{93m}Tc	9E+4	3E+5	1E–4	5E–7	—	—
			St. wall (1E+5)	—	—	—	2E–3	2E–2
		W, see ^{93m}Tc	—	4E+5	2E–4	5E–7	—	—
43	Technetium-104[2]	D, see ^{93m}Tc	2E+4	7E–4	3E–5	1E–7	—	—
			St. wall (3E+4)	—	—	—	4E–4	4E–3
		W, see ^{93m}Tc	—	9E+4	4E–5	1E–7	—	—
44	Ruthenium-94[2]	D, all compounds except those given for W and Y	2E+4	4E+4	2E–5	6E–8	2E–4	2E–3
		W, halides	—	6E+4	3E–5	9E–8	—	—
		Y, oxides and hydroxides	—	6E+4	2E–5	8E–8	—	—
44	Ruthenium-97	D, see ^{94}Ru	8E+3	2E+4	8E–6	3E–8	1E–4	1E–3
		W, see ^{94}Ru	—	1E+4	5E–6	2E–8	—	—
		Y, see ^{94}Ru	—	1E+4	5E–6	2E–8	—	—
44	Ruthenium-103	D, see ^{94}Ru	2E+3	2E+3	7E–7	2E–9	3E–5	3E–4
		W, see ^{94}Ru	—	1E+3	4E–7	1E–9	—	—
		Y, see ^{94}Ru	—	6E+2	3E–7	9E–10	—	—
44	Ruthenium-105	D, see ^{94}Ru	5E+3	1E+4	6E–6	2E–8	7E–5	7E–4
		W, see ^{94}Ru	—	1E+4	6E–6	2E–8	—	—
		Y, see ^{94}Ru	—	1E+4	5E–6	2E–8	—	—
44	Ruthenium-106	D, see ^{94}Ru	2E+2	9E+1	4E–8	1E–10	—	—
			LLI wall (2E+2)	—	—	—	3E–6	3E–5
		W, see ^{94}Ru	—	5E+1	2E–8	8E–11	—	—
		Y, see ^{94}Ru	—	1E+1	5E–9	2E–11	—	—
45	Rhodium-99m	D, all compounds except those given for W and Y	2E+4	6E+4	2E–5	8E–8	2E–4	2E–3
		W, halides	—	8E+4	3E–5	1E–7	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
		Y, oxides and hydroxides	—	7E+4	3E–5	9E–8	—	—
45	Rhodium-99	D, see ^{99m}Rh	2E+3	3E+3	1E–6	4E–9	3E–5	3E–4
		W, see ^{99m}Rh	—	2E+3	9E–7	3E–9	—	—
		Y, see ^{99m}Rh	—	2E+3	8E–7	3E–9	—	—
45	Rhodium-100	D, see ^{99m}Rh	2E+3	5E+3	2E–6	7E–9	2E–5	2E–4
		W, see ^{99m}Rh	—	4E+3	2E–6	6E–9	—	—
		Y, see ^{99m}Rh	—	4E+3	2E–6	5E–9	—	—
45	Rhodium-101m	D, see ^{99m}Rh	6E+3	1E+4	5E–6	2E–8	8E–5	8E–4
		W, see ^{99m}Rh	—	8E+3	4E–6	1E–8	—	—
		Y, see ^{99m}Rh	—	8E+3	3E–6	1E–8	—	—
45	Rhodium-101	D, see ^{99m}Rh	2E+3	5E+2	2E–7	7E–10	3E–5	3E–4
		W, see ^{99m}Rh	—	8E+2	3E–7	1E–9	—	—
		Y, see ^{99m}Rh	—	2E+2	6E–8	2E–10	—	—
45	Rhodium-102m	D, see ^{99m}Rh	1E+3	5E+2	2E–7	7E–10	—	—
			LLI wall (1E+3)	—	—	—	2E–5	2E–4
		W, see ^{99m}Rh	—	4E+2	2E–7	5E–10	—	—
		Y, see ^{99m}Rh	—	1E+2	5E–8	2E–10	—	—
45	Rhodium-102	D, see ^{99m}Rh	6E+2	9E+1	4E–8	1E–10	8E–6	8E–5
		W, see ^{99m}Rh	—	2E+2	7E–8	2E–10	—	—
		Y, see ^{99m}Rh	—	6E+1	2E–8	8E–11	—	—
45	Rhodium-103m[2]	D, see ^{99m}Rh	4E+5	1E+6	5E–4	2E–6	6E–3	6E–2
		W, see ^{99m}Rh	—	1E+6	5E–4	2E–6	—	—
		Y, see ^{99m}Rh	—	1E+6	5E–4	2E–6	—	—
45	Rhodium-105	D, see ^{99m}Rh	4E+3	1E+4	5E–6	2E–8	—	—
			LLI wall (4E+3)	—	—	—	5E–5	5E–4
		Y, see ^{99m}Rh	—	6E+3	2E–6	8E–9	—	—
45	Rhodium-106m	D, see ^{99m}Rh	8E+3	3E+4	1E–5	4E–8	1E–4	1E–3
		W, see ^{99m}Rh	—	4E+4	2E–5	5E–8	—	—
		Y, see ^{99m}Rh	—	4E+4	1E–5	5E–8	—	—
45	Rhodium-107[2]	D, see ^{99m}Rh	7E+4	2E+5	1E–4	3E–7	—	—
			St. wall (9E+4)	—	—	—	1E–3	1E–2
		W, see ^{99m}Rh	—	3E+5	1E–4	4E–7	—	—
		Y, see ^{99m}Rh	—	3E+5	1E–4	3E–7	—	—
46	Palladium-100	D, all compounds except those given for W and Y	1E+3	1E+3	6E–7	2E–9	2E–5	2E–4
		W, nitrates	—	1E+3	5E–7	2E–9	—	—
		Y, oxides and hydroxides	—	1E+3	6E–7	2E–9	—	—
46	Palladium-101	D, see ^{100}Pd	1E+4	3E+4	1E–5	5E–8	2E–4	2E–3
		W, see ^{100}Pd	—	3E+4	1E–5	5E–8	—	—
		Y, see ^{100}Pd	—	3E+4	1E–5	4E–8	—	—
46	Palladium-103	D, see ^{100}Pd	6E+3	6E+3	3E–6	9E–9	—	—
			LLI wall (7E+3)	—	—	—	1E–4	1E–3
		W, see ^{100}Pd	—	4E+3	2E–6	6E–9	—	—
		Y, see ^{100}Pd	—	4E+3	1E–6	5E–9	—	—
46	Palladium-107	D, see ^{100}Pd	3E+4	2E+4	9E–6	—	—	—
			LLI wall (4E+4)	Kidneys (2E+4)	—	3E–8	5E–4	5E–3
		W, see ^{100}Pd	—	7E+3	3E–6	1E–8	—	—
		Y, see ^{100}Pd	—	4E+2	2E–7	6E–10	—	—
46	Palladium-109	D, see ^{100}Pd	2E+3	6E+3	3E–6	9E–9	3E–5	3E–4
		W, see ^{100}Pd	—	5E+3	2E–6	8E–9	—	—
		Y, see ^{100}Pd	—	5E+3	2E–6	6E–9	—	—
47	Silver-102[2]	D, all compounds except those given for W and Y	5E+4	2E+5	8E–5	2E–7	—	—
			St. wall (6E+4)	—	—	—	9E–4	9E–3
		W, nitrates and sulfides	—	2E+5	9E–5	3E–7	—	—
		Y, oxides and hydroxides	—	2E+5	8E–5	3E–7	—	—
47	Silver-103[2]	D, see ^{102}Ag	4E+4	1E+5	4E–5	1E–7	5E–4	5E–3
		W, see ^{102}Ag	—	1E+5	5E–5	2E–7	—	—
		Y, see ^{102}Ag	—	1E+5	5E–5	2E–7	—	—
47	Silver-104m[2]	D, see ^{102}Ag	3E+4	9E+4	4E–5	1E–7	4E–4	4E–3
		W, see ^{102}Ag	—	1E+5	5E–5	2E–7	—	—
		Y, see ^{102}Ag	—	1E+5	5E–5	2E–7	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
47	Silver-104[2]	D, see ^{102}Ag	2E+4	7E+4	3E–5	1E–7	3E–4	3E–3
		W, see ^{102}Ag	—	1E+5	6E–5	2E–7	—	—
		Y, see ^{102}Ag	—	1E+5	6E–5	2E–7	—	—
47	Silver-105	D, see ^{102}Ag	3E+3	1E+3	4E–7	1E–9	4E–5	4E–4
		W, see ^{102}Ag	—	2E+3	7E–7	2E–9	—	—
		Y, see ^{102}Ag	—	2E+3	7E–7	2E–9	—	—
47	Silver 106m	D, see ^{102}Ag	8E+2	7E+2	3E–7	1E–9	1E–5	1E–4
		W, see ^{102}Ag	—	9E+2	4E–7	1E–9	—	—
		Y, see ^{102}Ag	—	9E+2	4E–7	1E–9	—	—
47	Silver-106[2]	D, see ^{102}Ag	6E+4	2E+5	8E–5	3E–7	—	—
			St. Wall (6E+4)	—	—	—	9E–4	9E–3
		W, see ^{102}Ag	—	2E+5	9E–5	3E–7	—	—
		Y, see ^{102}Ag	—	2E+5	8E–5	3E–7	—	—
47	Silver-108m	D, see ^{102}Ag	6E+2	2E+2	8E–8	3E–10	9E–6	9E–5
		W, see ^{102}Ag	—	3E+2	1E–7	4E–10	—	—
		Y, see ^{102}Ag	—	2E+1	1E–8	3E–11	—	—
47	Silver-110m	D, see ^{102}Ag	5E+2	1E+2	5E–8	2E–10	6E–6	6E–5
		W, see ^{102}Ag	—	2E+2	8E–8	3E–10	—	—
		Y, see ^{102}Ag	—	9E+1	4E–8	1E–10	—	—
47	Silver-111	D, see ^{102}Ag	9E+2	2E+3	6E–7	—	—	—
			LLI wall (1E+3)	Liver (2E+3)	—	2E–9	2E–5	2E–4
		W, see ^{102}Ag	—	9E+2	4E–7	1E–9	—	—
		Y, see ^{102}Ag	—	9E+2	4E–7	1E–9	—	—
47	Silver-112	D, see ^{102}Ag	3E+3	8E+3	3E–6	1E–8	4E–5	4E–4
		W, see ^{102}Ag	—	1E+4	4E–6	1E–8	—	—
		Y, see ^{102}Ag	—	9E+3	4E–6	1E–8	—	—
47	Silver-115[2]	D, see ^{102}Ag	3E+4	9E+4	4E–5	1E–7	—	—
			St. wall (3E+4)	—	—	—	4E–4	4E–3
		W, see ^{102}Ag	—	9E+4	4E–5	1E–7	—	—
		Y, see ^{102}Ag	—	8E+4	3E–5	1E–7	—	—
48	Cadmium-104[2]	D, all compounds except those given for W and Y	2E+4	7E+4	3E–5	9E–8	3E –4	3E–3
		W, sulfides, halides, and nitrates	—	1E+5	5E–5	2E–7	—	—
		Y, oxides and hydroxides	—	1E+5	5E–5	2E–7	—	—
48	Cadmium-107	D, see ^{104}Cd	2E+4	5E+4	2E–5	8E–8	3E–4	3E–3
		W, see ^{104}Cd	—	6E+4	2E–5	8E–8	—	—
		Y, see ^{104}Cd	—	5E+4	2E–5	7E–8	—	—
48	Cadmium-109	D, see ^{104}Cd	3E+2	4E+1	1E–8	—	—	—
			Kidneys (4E+2)	Kidneys (5E+1)	—	7E–11	6E–6	6E–5
		W, see ^{104}Cd	—	1E+2	5E–8	—	—	—
			—	Kidneys (1E+2)	—	2E–10	—	—
		Y, see ^{104}Cd	—	1E+2	5E–8	2E–10	—	—
48	Cadmium-113m	D, see ^{104}Cd	2E+1	2E+0	1E–9	—	—	—
			Kidneys (4E+1)	Kidneys (4E+0)	—	5E–12	5E–7	5E–6
		W, see ^{104}Cd	—	8E+0	4E–9	—	—	—
			—	Kidneys (1E+1)	—	2E–11	—	—
		Y, see ^{104}Cd	—	1E+1	5E–9	2E–11	—	—
48	Cadmium-113	D, see ^{104}Cd	2E+1	2E+0	9E–10	—	—	—
			Kidneys (3E+1)	Kidneys (3E+0)	—	5E–12	4E–7	4E–6
		W, see ^{104}Cd	—	8E+0	3E–9	—	—	—
			—	Kidneys (1E+1)	—	2E–11	—	—
		Y, see ^{104}Cd	—	1E+1	6E–9	2E–11	—	—
48	Cadmium-115m	D, see ^{104}Cd	3E+2	5E+1	2E–8	—	4E–6	4E–5
			—	Kidneys (8E+1)	—	1E–10	—	—
		W, see ^{104}Cd	—	1E+2	5E–8	2E–10	—	—
		Y, see ^{104}Cd	—	1E+2	6E–8	2E–10	—	—
48	Cadmium-115	D, see ^{104}Cd	9E+2	1E+3	6E–7	2E–9	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
			LLI wall (1E+3)	—	—	—	1E–5	1E–4
		W, see ^{104}Cd	—	1E+3	5E–7	2E–9	—	—
		Y, see ^{104}Cd	—	1E+3	6E–7	2E–9	—	—
48	Cadmium-117m	D, see ^{104}Cd	5E+3	1E+4	5E–6	2E–8	6E–5	6E–4
		W, see ^{104}Cd	—	2E+4	7E6	2E–8	—	—
		Y, see ^{104}Cd	—	1E+4	6E–6	2E–8	—	—
48	Cadmium-117	D, see ^{104}Cd	5E+3	1E+4	5E–6	2E–8	6E–5	6E–4
		W, see ^{104}Cd	—	2E+4	7E–6	2E–8	—	—
		Y, see ^{104}Cd	—	1E+4	6E–6	2E–8	—	—
49	Indium-109	D, all compounds except those given for W	2E+4	4E+4	2E–5	6E–8	3E–4	3E–3
		W, oxides, hydroxides, halides, and nitrates	—	6E+4	3E–5	9E–8	—	—
49	Indium-110[2] (69.1 min)	D, see ^{109}In	2E+4	4E+4	2E–5	6E–8	2E–4	2E–3
		W, see ^{109}In	—	6E+4	2E–5	8E–8	—	—
49	Indium-110 (4.9 h)	D, see ^{109}In	5E+3	2E+4	7E–6	2E–8	7E–5	7E–4
		W, see ^{109}In	—	2E+4	8E–6	3E–8	—	—
49	Indium-111	D, see ^{109}In	4E+3	6E+3	3E–6	9E–9	6E–5	6E–4
		W, see ^{109}In	—	6E+3	3E–6	9E–9	—	—
49	Indium-112[2]	D, see ^{109}In	2E+5	6E+5	3E–4	9E–7	2E–3	2E–2
		W, see ^{109}In	—	7E+5	3E–4	1E–6	—	—
49	Indium-113m[2]	D, see ^{109}In	5E+4	1E+5	6E–5	2E–7	7E–4	7E–3
		W, see ^{109}In	—	2E+5	8E–5	3E–7	—	—
49	Indium-114m	D, see ^{109}In	3E+2	6E+1	3E–8	9E–11	—	—
			LLI wall (4E+2)	—	—	—	5E–6	5E–5
		W, see ^{109}In	—	1E+2	4E–8	1E–10	—	—
49	Indium-115m	D, see ^{109}In	1E+4	4E+4	2E–5	6E–8	2E–4	2E–3
		W, see ^{109}In	—	5E+4	2E–5	7E–8	—	—
49	Indium-115	D, see ^{109}In	4E+1	1E+0	6E–10	2E–12	5E–7	5E–6
		W, see ^{109}In	—	5E+0	2E–9	8E–12	—	—
49	Indium-116m[2]	D, see ^{109}In	2E+4	8E+4	3E–5	1E–7	3E–4	3E–3
		W, see ^{109}In	—	1E+5	5E–5	2E–7	—	—
49	Indium-117m[2]	D, see ^{109}In	1E+4	3E+4	1E–5	5E–8	2E–4	2E–3
		W, see ^{109}In	—	4E+4	2E–5	6E–8	—	—
49	Indium-119m[2]	D, see ^{109}In	4E+4	1E+5	5E–5	2E–7	—	—
			St. wall (5E+4)	—	—	—	7E–4	7E–3
		W, see ^{109}In	—	1E+5	6E–5	2E–7	—	—
50	Tin-110	D, all compounds except those given for W	4E+3	1E+4	5E–6	2E–8	5E–5	5E–4
		W, sulfides, oxides, hydroxides, halides, nitrates, and stannic phosphate	—	1E+4	5E–6	2E–8	—	—
50	Tin-111[2]	D, see ^{110}Sn	7E+4	2E+5	9E–5	3E–7	1E–3	1E–2
		W, see ^{110}Sn	—	3E+5	1E–4	4E–7	—	—
50	Tin-113	D, see ^{110}Sn	2E+3	1E+3	5E–7	2E–9	—	—
			LLI wall (2E+3)	—	—	—	3E–5	3E–4
		W, see ^{110}Sn	—	5E+2	2E–7	8E–10	—	—
50	Tin-117m	D, see ^{110}Sn	2E+3	1E+3	5E–7	—	—	—
			LLI wall (2E+3)	Bone surf (2E+3)	—	3E–9	3E–5	3E–4
		W, see ^{110}Sn	—	1E+3	6E–7	2E–9	—	—
50	Tin-119m	D, see ^{110}Sn	3E+3	2E+3	1E–6	3E–9	—	—
			LLI wall (4E+3)	—	—	—	6E–5	6E–4
		W, see ^{110}Sn	—	1E+3	4E–7	1E–9	—	—
50	Tin-121m	D, see ^{110}Sn	3E+3	9E+2	4E–7	1E–9	—	—
			LLI wall (4E+3)	—	—	—	5E–5	5E–4
		W, see ^{110}Sn	—	5E+2	2E–7	8E–10	—	—
50	Tin-121	D, see ^{110}Sn	6E+3	2E+4	6E–6	2E–8	—	—
			LLI wall (6E+3)	—	—	—	8E–5	8E–4

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
		W, see ^{110}Sn	—	1E+4	5E–6	2E–8	—	—
50	Tin-123m[2]	D, see ^{110}Sn	5E+4	1E+5	5E–5	2E–7	7E–4	7E–3
		W, see ^{110}Sn	—	1E+5	6E–5	2E–7	—	—
50	Tin-123	D, see ^{110}Sn	5E+2	6E+2	3E–7	9E–10	—	—
			LLI wall (6E+2)	—	—	—	9E–6	9E–5
		W, see ^{110}Sn	—	2E+2	7E–8	2E–10	—	—
50	Tin-125	D, see ^{110}Sn	4E+2	9E+2	4E–7	1E–9	—	—
			LLI wall (5E+2)	—	—	—	6E–6	6E–5
		W, see ^{110}Sn	—	4E+2	1E–7	5E–10	—	—
50	Tin-126	D, see ^{110}Sn	3E+2	6E+1	2E–8	8E–11	4E–6	4E–5
		W, see ^{110}Sn	—	7E+1	3E–8	9E–11	—	—
50	Tin-127	D, see ^{110}Sn	7E+3	2E+4	8E–6	3E–8	9E–5	9E–4
		W, see ^{110}Sn	—	2E+4	8E–6	3E–8	—	—
50	Tin-128[2]	D, see ^{110}Sn	9E+3	3E+4	1E–5	4E–8	1E–4	1E–3
		W, see ^{110}Sn	—	4E+4	1E–5	5E–8	—	—
51	Antimony-115[2]	D, all compounds except those given for W	8E+4	2E+5	1E–4	3E–7	1E–3	1E–2
		W, oxides, hydroxides, halides, sulfides, sulfates, and nitrates	—	3E+5	1E–4	4E–7	—	—
51	Antimony-116m[2]	D, see ^{115}Sb	2E+4	7E+4	3E–5	1E–7	3E–4	3E–3
		W, see ^{115}Sb	—	1E+5	6E–5	2E–7	—	—
51	Antimony-116[2]	D, see ^{115}Sb	7E+4	3E+5	1E–4	4E–7	—	—
			St. wall (9E+4)	—	—	—	1E–3	1E–2
		W, see ^{115}Sb	—	3E+5	1E–4	5E–7	—	—
51	Antimony-117	D, see ^{115}Sb	7E+4	2E+5	9E–5	3E–7	9E–4	9E–3
		W, see ^{115}Sb	—	3E+5	1E–4	4E–7	—	—
51	Antimony-118m	D, see ^{115}Sb	6E+3	2E+4	8E–6	3E–8	7E–5	7E–4
		W, see ^{115}Sb	5E+3	2E+4	9E–6	3E–8	—	—
51	Antimony-119	D, see ^{115}Sb	2E+4	5E+4	2E–5	6E–8	2E–4	2E–3
		W, see ^{115}Sb	2E+4	3E+4	1E–5	4E–8	—	—
51	Antimony-120[2] (16 min)	D, see ^{115}Sb	1E+5	4E+5	2E–4	6E–7	—	—
			St. Wall (2E+5)	—	—	—	2E–3	2E–2
		W, see ^{115}Sb	—	5E+5	2E–4	7E–7	—	—
51	Antimony-120 (5.76 d)	D, see ^{115}Sb	1E+3	2E+3	9E–7	3E–9	1E–5	1E–4
		W, see ^{115}Sb	9E+2	1E+3	5E–7	2E–9	—	—
51	Antimony-122	D, see ^{115}Sb	8E+2	2E+3	1E–6	3E–9	—	—
			LLI wall (8E+2)	—	—	—	1E–5	1E–4
		W, see ^{115}Sb	7E+2	1E+3	4E–7	2E–9	—	—
51	Antimony-124m[2]	D, see ^{115}Sb	3E+5	8E+5	4E–4	1E–6	3E–3	3E–2
		W, see ^{115}Sb	2E+5	6E+5	2E–4	8E–7	—	—
51	Antimony-124	D, see ^{115}Sb	6E+2	9E+2	4E–7	1E–9	7E–6	7E–5
		W, see ^{115}Sb	5E+2	2E+2	1E–7	3E–10	—	—
51	Antimony-125	D, see ^{115}Sb	2E+3	2E+3	1E–6	3E–9	3E–5	3E–4
		W, see ^{115}Sb	—	5E+2	2E–7	7E–10	—	—
51	Antimony-126m[2]	D, see ^{115}Sb	5E+4	2E+5	8E–5	3E–7	—	—
			St. wall (7E+4)	—	—	—	9E–4	9E–3
		W, see ^{115}Sb	—	2E+5	8E–5	3E–7	—	—
51	Antimony-126	D, see ^{115}Sb	6E+2	1E+3	5E–7	2E–9	7E–6	7E–5
		W, see ^{115}Sb	5E+2	5E+2	2E–7	7E–10	—	—
51	Antimony-127	D, see ^{115}Sb	8E+2	2E+3	9E–7	3E–9	—	—
			LLI wall (8E+2)	—	—	—	1E–5	1E–4
		W, see ^{115}Sb	7E+2	9E+2	4E–7	1E–9	—	—
51	Antimony-128[2] (10.4 min)	D, see ^{115}Sb	8E+4	4E+5	2E–4	5E–7	—	—
			St. wall (1E+5)	—	—	—	1E–3	1E–2
		W, see ^{115}Sb	—	4E+5	2E–4	6E–7	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
51	Antimony-128 (9.01 h)	D, see ^{115}Sb	1E+3	4E+3	2E–6	6E–9	2E–5	2E–4
		W, see ^{115}Sb	—	3E+3	1E–6	5E–9	—	—
51	Antimony-129	D, see ^{115}Sb	3E+3	9E+3	4E–6	1E–8	4E–5	4E–4
		W, see ^{115}Sb	—	9E+3	4E–6	1E–8	—	—
51	Antimony-130[2]	D, see ^{115}Sb	2E+4	6E+4	3E–5	9E–8	3E–4	3E–3
		W, see ^{115}Sb	—	8E+4	3E–5	1E–7	—	—
51	Antimony-131[2]	D, see ^{115}Sb	1E+4	2E+4	1E–5	—	—	—
			Thyroid (2E+4)	Thyroid (4E+4)	—	6E–8	2E–4	2E–3
		W, see ^{115}Sb	—	2E+4	1E–5	—	—	—
			—	Thyroid (4E+4)	—	6E–8	—	—
52	Tellurium-116	D, all compounds except those given for W	8E+3	2E+4	9E–6	3E–8	1E–4	1E–3
		W, oxides, hydroxides, and nitrates	—	3E+4	1E–5	4E–8	—	—
52	Tellurium-121m	D, see ^{116}Te	5E+2	2E+2	8E–8	—	—	—
			Bone surf (7E+2)	Bone surf (4E+2)	—	5E–10	1E–5	1E–4
		W, see ^{116}Te	—	4E+2	2E–7	6E–10	—	—
52	Tellurium-121	D, see ^{116}Te	3E+3	4E+3	2E–6	6E–9	4E–5	4E–4
		W, see ^{116}Te	—	3E+3	1E–6	4E–9	—	—
52	Tellurium-123m	D, see ^{116}Te	6E+2	2E+2	9E–8	—	—	—
			Bone surf (1E+3)	Bone surf (5E+2)	—	8E–10	1E–5	1E–4
		W, see ^{116}Te	—	5E+2	2E–7	8E–10	—	—
52	Tellurium-123	D, see ^{116}Te	5E+2	2E+2	8E–8	—	—	—
			Bone surf (1E+3)	Bone surf (5E+2)	—	7E–10	2E–5	2E–4
		W, see ^{116}Te	—	4E+2	2E–7	—	—	—
			—	Bone surf (1E+3)	—	2E–9	—	—
52	Tellurium-125m	D, see ^{116}Te	1E+3	4E+2	2E–7	—	—	—
			Bone surf (1E+3)	Bone surf (1E+3)	—	1E–9	2E–5	2E–4
		W, see ^{116}Te	—	7E+2	3E–7	1E–9	—	—
52	Tellurium-127m	D, see ^{116}Te	6E+2	3E+2	1E–7	—	9E–6	9E–5
			—	Bone surf (4E+2)	—	6E–10	—	—
		W, see ^{116}Te	—	3E+2	1E–7	4E–10	—	—
52	Tellurium-127	D, see ^{116}Te	7E+3	2E+4	9E–6	3E–8	1E–4	1E–3
		W, see ^{116}Te	—	2E+4	7E–6	2E–8	—	—
52	Tellurium-129m	D, see ^{116}Te	5E+2	6E+2	3E–7	9E–10	7E–6	7E–5
		W, see ^{116}Te	—	2E+2	1E–7	3E–10	—	—
52	Tellurium-129[2]	D, see ^{116}Te	3E+4	6E+4	3E–5	9E–8	4E–4	4E–3
		W, see ^{116}Te	—	7E+4	3E–5	1E–7	—	—
52	Tellurium-131m	D, see ^{116}Te	3E+2	4E+2	2E–7	—	—	—
			Thyroid (6E+2)	Thyroid (1E+3)	—	2E–9	8E–6	8E–5
		W, see ^{116}Te	—	4E+2	2E–7	—	—	—
			—	Thyroid (9E+2)	—	1E–9	—	—
52	Tellurium-131[2]	D, see ^{116}Te	3E+3	5E+3	2E–6	—	—	—
			Thyroid (6E+3)	Thyroid (1E+4)	—	2E–8	8E–5	8E–4
		W, see ^{116}Te	—	5E+3	2E–6	—	—	—
			—	Thyroid (1E+4)	—	2E–8	—	—
52	Tellurium-132	D, see ^{116}Te	2E+2	2E+2	9E–8	—	—	—
			Thyroid (7E+2)	Thyroid (8E+2)	—	1E–9	9E–6	9E–5
		W, see ^{116}Te	—	2E+2	9E–8	—	—	—
			—	Thyroid (6E+2)	—	9E–10	—	—
52	Tellurium-133m[2]	D, see ^{116}Te	3E+3	5E+3	2E–6	—	—	—
			Thyroid (6E+3)	Thyroid (1E+4)	—	2E–8	9E–5	9E–4

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
		W, see ^{116}Te	—	5E+3	2E–6	—	—	—
			—	Thyroid (1E+4)	—	2E–8	—	—
52	Tellurium-133[2]	D, see ^{116}Te	1E+4	2E–4	9E–6	—	—	—
			Thyroid (3E+4)	Thyroid (6E+4)	—	—8E–8	4E–4	4E–3
		W, see ^{116}Te	—	5E+3	2E–6	—	—	—
			—	Thyroid (6E+4)	—	8E–8	—	—
52	Tellurium-134[2]	D, see ^{116}Te	2E+4	2E+4	1E–5	—	—	—
			Thyroid (2E+4)	—	—	7E–8	3E–4	3E–3
		W, see ^{116}Te	—	2E+4	1E–5	—	—	—
			—	Thyroid (5E+4)	—	7E–8	—	—
53	Iodine-120m[2]	D, all compounds	1E+4	2E+4	9E–6	3E–8	—	—
			Thyroid (1E+4)	—	—	—	2E–4	2E–3
53	Iodine-120[2]	D, all compounds	4E+3	9E+3	4E–6	—	—	—
			Thyroid (8E+3)	Thyroid (1E+4)	—	2E–8	1E–4	1E–3
53	Iodine-121	D, all compounds	1E+4	2E+4	8E–6	—	—	—
			Thyroid (3E+4)	Thyroid (5E+4)	—	7E–8	4E–4	4E–3
53	Iodine-123	D, all compounds	3E+3	6E+3	3E–6	—	—	—
			Thyroid (1E+4)	Thyroid (2E+4)	—	2E–8	1E–4	1E–3
53	Iodine-124	D, all compounds	5E+1	8E+1	3E–8	—	—	—
			Thyroid (2E+2)	Thyroid (3E+2)	—	4E–10	2E–6	2E–5
53	Iodine-125	D, all compounds	4E+1	6E+1	3E–8	—	—	—
			Thyroid (1E+2)	Thyroid (2E+2)	—	3E–10	2E–6	2E–5
53	Iodine-126	D, all compounds	2E+1	4E+1	1E–8	—	—	—
			Thyroid (7E+1)	Thyroid (1E+2)	—	2E–10	1E–6	1E–5
53	Iodine-128[2]	D, all compounds	4E+4	1E+5	5E–5	2E–7	—	—
			St. wall (6E+4)	—	—	—	8E–4	8E–3
53	Iodine-129	D, all compounds	5E+0	9E+0	4E–9	—	—	—
			Thyroid (2E+1)	Thyroid (3E+1)	—	4E–11	2E–7	2E–6
53	Iodine-130	D, all compounds	4E+2	7E+2	3E–7	—	—	—
			Thyroid (1E+3)	Thyroid (2E+3)	—	3E–9	2E–5	2E–4
53	Iodine-131	D, all compounds	4E+2	7E+2	3E–7	—	—	—
			Thyroid (9E+1)	Thyroid (2E+2)	—	2E–10	1E–6	1E–5
53	Iodine-132m[2]	D, all compounds	4E+3	8E+3	4E–6	—	—	—
			Thyroid (1E+4)	Thyroid (2E+4)	—	3E–8	1E–4	1E–3
53	Iodine-132	D, all compounds	4E+3	8E+3	3E–6	—	—	—
			Thyroid (9E+3)	Thyroid (1E+4)	—	2E–8	1E–4	1E–3
53	Iodine-133	D, all compounds	1E+2	3E+2	1E–7	—	—	—
			Thyroid (5E+2)	Thyroid (5E+2)	—	1E–9	7E–6	7E–5
53	Iodine-134[2]	D, all compounds	2E+4	5E+4	2E–5	6E–8	—	—
			Thyroid (3E+4)	—	—	—	4E–4	4E–3
53	Iodine-135	D, all compounds	8E+2	2E+3	7E–7	—	—	—
			Thyroid (3E+3)	Thyroid (4E+3)	—	6E–9	3E–5	3E–4
54	Xenon-120[2]	Submersion[1]	—	—	1E–5	4E–8	—	—
54	Xenon-121[2]	Submersion[1]	—	—	2E–6	1E–8	—	—
54	Xenon-122	Submersion[1]	—	—	7E–5	3E–7	—	—
54	Xenon-123	Submersion[1]	—	—	6E–6	3E–8	—	—
54	Xenon-125	Submersion[1]	—	—	2E–5	7E–8	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
54	Xenon-127	Submersion[1]	—	—	1E–5	6E–8	—	—
54	Xenon-129m	Submersion[1]	—	—	2E–4	9E–7	—	—
54	Xenon-131m	Submersion[1]	—	—	4E–4	2E–6	—	—
54	Xenon-133m	Submersion[1]	—	—	1E–4	6E–7	—	—
54	Xenon-133	Submersion[1]	—	—	1E–4	5E–7	—	—
54	Xenon-135[2]	Submersion[1]	—	—	9E–6	4E–8	—	—
54	Xenon-135	Submersion[1]	—	—	1E–5	7E–8	—	—
54	Xenon-138	Submersion[1]	—	—	4E–6	2E–8	—	—
55	Cesium-125[2]	D, all compounds	5E+4	1E+5	6E–5	2E–7	—	—
			St. wall (9E+4)	—	—	—	1E–3	1E–2
55	Cesium-127	D, all compounds	6E+4	9E+4	4E–5	1E–7	9E–4	9E–3
55	Cesium-129	D, all compounds	2E+4	3E+4	1E–5	5E–8	3E–4	3E–3
55	Cesium-130[2]	D, all compounds	6E+4	2E+5	8E–5	3E–7	—	—
			St. wall (1E+5)	—	—	—	1E–3	1E–2
55	Cesium-131	D, all compounds	2E+4	3E+4	1E–5	4E–8	3E–4	3E–3
55	Cesium-132	D, all compounds	3E+3	4E+3	2E–6	6E–9	4E–5	3E–3
55	Cesium-134m	D, all compounds	1E+5	1E+5	5E–5	2E–7	—	—
			St. wall (1E+5)	—	—	—	2E–3	2E–2
55	Cesium-134	D, all compounds	7E+1	1E+2	4E–8	2E–10	9E–7	9E–6
55	Cesium-135m[2]	D, all compounds	1E+5	2E+5	8E–5	3E–7	1E–3	1E–2
55	Cesium-135	D, all compounds	7E+2	1E+3	5E–7	2E–9	1E–5	1E–4
55	Cesium-136	D, all compounds	4E+2	7E+2	3E–7	9E–10	6E–6	6E–5
55	Cesium-137	D, all compounds	4E+2	7E+2	3E–7	9E–10	6E–6	6E–5
55	Cesium-138[2]	D, all compounds	2E+4	6E+4	2E–5	8E–8	—	—
			St. wall (3E+4)	—	—	—	4E–4	4E–3
56	Barium-126[2]	D, all compounds	6E+3	2E+4	6E–6	2E–8	8E–5	8E–4
56	Barium-128	D, all compounds	5E+2	2E+3	7E–7	2E–9	7E–6	7E–5
56	Barium-131m[2]	D, all compounds	4E+5	1E+6	6E–4	2E–6	—	—
			St. Wall (5E+5	—	—	—	7E–3	7E–2
56	Barium-131	D, all compounds	3E+3	8E+3	3E–6	1E–8	4E–5	4E–4
56	Barium-133m	D, all compounds	2E+3	9E+3	4E–6	1E–8	—	—
			LLI wall (3E+3)	—	—	—	4E–5	4E–4
56	Barium-133	D, all compounds	2E+3	7E+2	3E–7	9E–10	2E–5	2E–4
56	Barium-135m	D, all compounds	3E+3	1E+4	5E–6	2E–8	4E–5	4E–4
56	Barium-139[2]	D, all compounds	1E+4	3E+4	1E–5	4E–8	2E–4	2E–3
56	Barium-140	D, all compounds	5E+2	1E+3	6E–7	2E–9	—	—
			LLI wall (6E+2)	—	—	—	8E–6	8E–5
56	Barium-141[2]	D, all compounds	2E+4	7E+4	3E–5	1E–7	3E–4	3E–3
56	Barium-142[2]	D, all compounds	5E+4	1E+5	6E–5	2E–7	7E–4	7E–3
57	Lanthanum-131[2]	D, all compounds except those given for W	5E+4	1E+5	5E–5	2E–7	6E–4	6E–3
		W, oxides and hydroxides	—	2E+5	7E–5	2E–7	—	—
57	Lanthanum-132	D, see [131]La	3E+3	1E+4	4E–6	1E–8	4E–5	4E–4
		W, see [131]La	—	1E+4	5E–6	2E–8	—	—
57	Lanthanum-135	D, see [131]La	4E+4	1E+5	4E–5	1E–7	5E–4	5E–3
		W, see [131]La	—	9E+4	4E–5	1E–7	—	—
57	Lanthanum-137	D, see [131]La	1E+4	6E+1	3E–8	—	2E–4	2E–3
			—	Liver (7E+1)	—	1E–10	—	—
		W, see [131]La	—	3E+2	—	—	—	—
			—	Liver (3E+2)	—	4E–10	—	—
57	Lanthanum-138	D, see [131]La	9E+2	4E+0	1E–9	5E–12	1E–5	1E–4
		W, see [131]La	—	1E+1	6E–9	2E–11	—	—
57	Lanthanum-140	D, see [131]La	6E+2	1E+3	6E–7	2E–9	9E–6	9E–5
		W, see [131]La	—	1E+3	5E–7	2E–9	—	—
57	Lanthanum-141	D, see [131]La	4E+3	9E+3	4E–6	1E–8	5E–5	5E–4
		W, see [131]La	—	1E+4	5E–6	2E–8	—	—
57	Lanthanum-142[2]	D, see [131]La	8E+3	2E+4	9E–6	3E–8	1E–4	1E–3
		W, see [131]La	—	3E+4	1E–5	5E–8	—	—
57	Lanthanum-143[2]	D, see [131]La	4E+4	1E+5	4E–5	1E–7	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
			St. wall (4E+4)	—	—	—	5E–4	5E–3
		W, see ^{131}La	—	9E+4	4E–5	1E–7	—	—
58	Cerium-134	W, all compounds except those given for Y	5E+2	7E+2	3E–7	1E–9	—	—
			LLI wall (2E+3)	—	—	—	3E–5	3E–4
		Y, oxides, hydroxides, and fluorides	—	7E+2	3E–7	9E–10	—	—
58	Cerium-135	W, see ^{134}Ce	2E+3	4E+3	2E–6	5E–9	2E–5	2E–4
		Y, see ^{134}Ce	—	4E+3	1E–6	5E–9	—	—
58	Cerium-137m	W, see ^{134}Ce	2E+3	4E+3	2E–6	6E–9	2E–5	2E–4
			LLI wall (2E+3)	—	—	—	3E–5	3E–4
		Y, see ^{134}Ce	—	4E+3	2E–6	5E–9	—	—
58	Cerium-137	W, see ^{134}Ce	5E+4	1E+5	6E–5	2E–7	7E–4	7E–3
		Y, see ^{134}Ce	—	1E+5	5E–5	2E–7	—	—
58	Cerium-139	W, see ^{134}Ce	5E+3	8E+2	3E–7	–91E	7E–5	7E–4
			LLI wall (2E+3)	—	—	—	3E–5	3E–4
		Y, see ^{134}Ce	—	6E+2	2E–7	8E–10	—	—
58	Cerium-143	W, see ^{134}Ce	1E+3	2E+3	8E–7	3E–9	—	—
			LLI wall (1E+3)	—	—	—	2E–5	2E–4
		Y, see ^{134}Ce	—	2E+3	7E–7	2E–9	—	—
58	Cerium-144	W, see ^{134}Ce	2E+2	3E+1	1E–8	4E–1	—	—
			LLI wall (3E+2)	—	—	—	3E–6	3E–5
		Y, see ^{134}Ce	—	1E+1	6E–9	2E–11	—	—
59	Praseodymium-136[2]	W, all compounds except those given for Y	5E+4	2E+5	1E–4	3E–7	—	—
			St. wall (7E+4)	—	—	—	1E–3	1E–2
		Y, oxides, hydroxides, carbides, and fluorides	—	2E+5	9E–5	3E–7	—	—
59	Praseodymium-137[2]	W, see ^{136}Pr	4E+4	2E+5	6E–5	2E–7	5E–4	5E–3
		Y, see ^{136}Pr	—	1E+5	6E–5	2E–7	—	—
59	Praseodymium-138m	W, see ^{136}Pr	1E+4	5E+4	2E–5	8E–8	1E–4	1E–3
		Y, see ^{136}Pr	—	4E+4	2E–5	6E–8	—	—
59	Praseodymium-139	W, see ^{136}Pr	4E+4	2E+5	1E+5	5E–5	2E–7	6E–4
		Y, see ^{136}Pr	—	1E+5	5E–5	2E–7	—	—
59	Praseodymium-142m[2]	W, see ^{136}Pr	8E+4	2E+5	7E–5	2E–7	1E–3	1E–2
		Y, see ^{136}Pr	—	1E+5	6E–5	2E–7	—	—
59	Praseodymium-142	W, see ^{136}Pr	1E+3	2E+3	9E–7	3E–9	1E–5	1E–4
		Y, see ^{136}Pr	—	2E+3	8E–7	3E–9	—	—
59	Praseodymium-143	W, see ^{136}Pr	9E+2	8E+2	3E–7	1E–9	—	—
			LLI Wall (1E+3)	—	—	—	2E–5	2E–4
		Y, see ^{136}Pr	—	7E+2	3E–7	9E–10	—	—
59	Praseodymium-144[2]	W, see ^{136}Pr	3E+4	1E+5	5E–5	2E–7	—	—
			St. wall (4E+4)	—	—	—	6E–4	6E–3
		Y, see ^{136}Pr	—	1E+5	5E–5	2E–7	—	—
59	Praseodymium-145	W, see ^{136}Pr	3E+3	9E+3	4E–6	1E–8	—	—
		Y, see ^{136}Pr	—	8E+3	3E–6	1E–8	—	—
59	Praseodymium-147[2]	W, see ^{136}Pr	5E+4	2E+5	8E–5	3E–7	—	—
			St. wall (8E+4)	—	—	—	1E–3	1E–2
		Y, see ^{136}Pr	—	2E+5	8E–5	3E–7	—	—
60	Neodymium-136[2]	W, all compounds except those given for Y	1E+4	6E+4	2E–5	8E–8	2E–4	2E–3
		Y, oxides, hydroxides, carbides, and fluorides	—	5E+4	2E–5	8E–8	—	—
60	Neodymium-138	W, see ^{136}Nd	2E+3	6E+3	3E–6	9E–9	3E–5	3E–4
		Y, see ^{136}Nd	—	5E+3	2E–6	7E–9	—	—
60	Neodymium-139m	W, see ^{136}Nd	5E+3	2E+4	7E–6	2E–8	7E–5	7E–4
		Y, see ^{136}Nd	—	1E+4	6E–6	2E–8	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
60	Neodymium-139[2]	W, see ^{136}Nd	9E+4	3E+5	1E–4	5E–7	1E–3	1E–2
		Y, see ^{136}Nd	—	3E+5	1E–4	4E–7	—	—
60	Neodymium-141	W, see ^{136}Nd	2E+5	7E+5	3E–4	1E–6	2E–3	2E–2
		Y, see ^{136}Nd	—	6E+5	3E–4	9E–7	—	—
60	Neodymium-147	W, see ^{136}Nd	1E+3	9E+2	4E–7	1E–9	—	—
			LLI wall (1E+3)	—	—	—	2E–5	2E–4
		Y, see ^{136}Nd	—	8E+2	4E–7	1E–9	—	—
60	Neodymium-149[2]	W, see ^{136}Nd	1E+4	3E+4	1E–5	4E–8	1E–4	1E–3
		Y, see ^{136}Nd	—	2E+4	1E–5	3E–8	—	—
60	Neodymium-151[2]	W, see ^{136}Nd	7E+4	2E+5	8E–5	3E–7	9E–4	9E–3
		Y, see ^{136}Nd	—	2E+5	8E–5	3E–7	—	—
61	Promethium-141[2]	W, all compounds except those given for Y	5E+4	2E+5	8E–5	3E–7	—	—
			St. wall (6E+4)	—	—	—	8E–4	8E–3
		Y, oxides, hydroxides, carbides, and fluorides	—	2E+5	7E–5	2E–7	—	—
61	Promethium-143	W, see ^{141}Pm	5E+3	6E+2	2E–7	8E–10	7E–5	7E–4
		Y, see ^{141}Pm	—	7E+2	3E–7	1E–9	—	—
61	Promethium-144	W, see ^{141}Pm	1E+3	1E+2	5E–8	2E–10	2E–5	2E–4
		Y, see ^{141}Pm	—	1E+2	5E–8	2E–10	—	—
61	Promethium-145	W, see ^{141}Pm	1E+4	2E+2	7E–8	—	1E–4	1E–3
			—	Bone surf (2E+2)	—	3E–10	—	—
		Y, see ^{141}Pm	—	2E+2	8E–8	3E–10	—	—
61	Promethium-146	W, see ^{141}Pm	2E+3	5E+1	2E–8	7E–11	2E–5	2E–4
		Y, see ^{141}Pm	—	4E+1	2E–8	6E–11	—	—
61	Promethium-147	W, see ^{141}Pm	4E+3	1E+2	5E–8	—	—	—
			LLI wall (5E+3)	Bone surf (2E+2)	—	3E–10	7E–5	7E–4
		Y, see ^{141}Pm	—	1E+2	6E–8	2E–10	—	—
61	Promethium-148m	W, see ^{141}Pm	7E+2	3E+2	1E–7	4E–10	1E–5	1E–4
		Y, see ^{141}Pm	—	3E+2	1E–7	5E–10	—	—
61	Promethium-148	W, see ^{141}Pm	4E+2	5E+2	2E–7	8E–10	—	—
			LLI wall (5E+2)	—	—	—	7E–6	7E–5
		Y, see ^{141}Pm	—	5E+2	2E–7	7E–10	—	—
61	Promethium-149	W, see ^{141}Pm	1E+3	2E+3	8E–7	3E–9	—	—
			LLI wall (1E+3)	—	—	—	2E–5	2E–4
		Y, see ^{141}Pm	—	2E+3	8E–7	2E–9	—	—
61	Promethium-150	W, see ^{141}Pm	5E+3	2E+4	8E–6	3E–8	7E–5	7E–4
		Y, see ^{141}Pm	—	2E+4	7E–6	2E–8	—	—
61	Promethium-151	W, see ^{141}Pm	2E+3	4E+3	1E–6	5E–9	2E–5	2E–4
		Y, see ^{141}Pm	—	3E+3	1E–6	4E–9	—	—
62	Samarium-141m[2]	W, all compounds	3E+4	1E+5	4E–5	1E–7	4E–4	4E–3
62	Samarium-141[2]	W, all compounds	5E+4	2E+5	–58E	2E–7	—	—
			St. wall (6E+4)	—	—	—	8E–4	8E–3
62	Samarium-142[2]	W, all compounds	8E+3	3E+4	1E–5	4E–8	1E–4	1E–3
62	Samarium-145	W, all compounds	6E+3	5E+2	2E–7	7E–10	8E–5	8E–4
62	Samarium-146	W, all compounds	1E+1	4E–2	1E–11	—	—	—
			Bone surf (3E+1)	Bone surf (6E–2)	—	9E–14	3E–7	3E–6
62	Samarium-151	W, all compounds	1E+4	1E+2	4E–8	—	—	—
			LLI wall (1E+4)	Bone surf (2E+2)	—	2E–10	2E–4	2E–3
62	Samarium-153	W, all compounds	2E+3	3E+3	1E–6	4–9	—	—
			LLI wall (2E+3)	—	—	—	3E–5	3E–4
62	Samarium-155[2]	W, all compounds	6E+4	2E+5	9E–5	3E–7	—	—
			St. wall (8E+4)	—	—	—	1E–3	1E–2
62	Samarium-156	W, all compounds	5E+3	9E+3	4E–6	1E–8	7E–5	7E–4
63	Europium-145	W, all compounds	2E+3	2E+3	8E–7	3E–9	2E–5	2E–4
63	Europium-146	W, all compounds	1E+3	1E–3	5E–7	2E–9	1E–5	1E–4
63	Europium-147	W, all compounds	3E+3	2E+3	7E–7	2E–9	4E–5	4E–4

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
63	Europium-148	W, all compounds	1E+3	4E+2	1E–7	5E–10	1E–5	1E–4
63	Europium-149	W, all compounds	1E+4	3E+3	1E–6	4E–9	2E–4	2E–3
63	Europium-150 (12.62 h)	W, all compounds	3E+3	8E+3	4E–6	1E–8	4E–5	4E–4
63	Europium-150 (34.2 y)	W, all compounds	8E+2	2E+1	8E–9	3E–11	1E–5	1E–4
63	Europium-152m	W, all compounds	3E+3	6E+3	3E–6	9E–9	4E–5	4E–4
63	Europium-152	W, all compounds	8E+2	2E+1	1E–8	3E–11	1E–5	1E–4
63	Europium-154	W, all compounds	5E+2	2E+1	8E–9	3E–11	7E–6	7E–5
63	Europium-155	W, all compounds	4E+3	9E+1	4E–8	—	5E–5	5E–4
			—	Bone surf (1E+2)	—	2E–10	—	—
63	Europium-156	W, all compounds	6E+2	5E+2	2E–7	6E–10	8E–6	8E–5
63	Europium-157	W, all compounds	2E+3	5E+3	2E–6	7E–9	3E–5	3E–4
63	Europium-158[2]	W, all compounds	2E+4	6E+4	2E–5	8E–8	3E–4	3E–3
64	Gadolinium-145[2]	D, all compounds except those given for W	5E+4	2E+5	6E–5	2E–7	—	—
			St. wall (5E+4)	—	—	—	6E–4	6E–3
		W, oxides, hydroxides, and fluorides	—	2E+5	7E–5	2E–7	—	—
64	Gadolinium-146	D, see ^{145}Gd	1E+3	1E+52	5E–8	2E–10	2E–5	2E–4
		W, see ^{145}Gd	—	3E+2	1E–7	4E–10	—	—
64	Gadolinium-147	D, see ^{145}Gd	2E+3	4E+3	2E–6	6E–9	3E–5	3E–4
		W, see ^{145}Gd	—	4E+3	1E–6	5E–9	—	—
64	Gadolinium-148	D, see ^{145}Gd	1E+1	8E–3	3E–12	—	—	—
			Bone surf (2E+1)	Bone surf (2E–2)	—	2E–14	3E–7	3E–6
		W, see ^{145}Gd	—	3E–2	1E–11	—	—	—
			—	Bone surf (6E–2)	—	8E–14	—	—
64	Gadolinium-149	D, see ^{145}Gd	3E+3	2E+3	9E–7	3E–9	4E–5	4E–4
		W, see ^{145}Gd	—	2E+3	1E–6	3E–9	—	—
64	Gadolinium-151	D, see ^{145}Gd	6E+3	4E+2	2E–7	—	9E–5	9E–4
			—	Bone surf (6E+2)	—	9E–10	—	—
		W, see ^{145}Gd	—	1E+3	5E–7	2E–9	—	—
64	Gadolinium-152	D, see ^{145}Gd	2E+1	1E–2	4E–12	—	—	—
			Bone surf (3E+1)	Bone surf (2E–2)	—	3E–14	4E–7	4E–6
		W, see ^{145}Gd	—	4E–2	2E–11	—	—	—
			—	Bone surf (8E–2)	—	1E–13	—	—
64	Gadolinium-153	D, see ^{145}Gd	5E+3	1E+2	6E–8	—	6E–5	6E–4
			—	Bone surf (2E+2)	—	3E–10	—	—
		W, see ^{145}Gd	—	6E+2	2E–7	8E–10	—	—
64	Gadolinium-159	D, see ^{145}Gd	3E+3	8E+3	3E–6	1E–8	4E–5	4E–4
		W, see ^{145}Gd	—	6E+3	2E–6	8E–9	—	—
65	Terbium-147[2]	W, all compounds	9E+3	3E+4	1E–5	5E–8	1E–4	1E–3
65	Terbium-149	W, all compounds	5E+3	7E+2	3E–7	1E–9	7E–5	7E–4
65	Terbium-150	W, all compounds	5E+3	2E+4	9E–6	3E–8	7E–5	7E–4
65	Terbium-151	W, all compounds	4E+3	9E+3	4E–6	1E–8	5E–5	5E–4
65	Terbium-153	W, all compounds	5E+3	7E+3	3E–6	1E–8	7E–5	7E–4
65	Terbium-154	W, all compounds	2E+3	4E+3	2E–6	6E–9	2E–5	2E–4
65	Terbium-155	W, all compounds	6E+3	8E+3	3E–6	1E–8	8E–5	8E–4
65	Terbium-156m (5.0 h)	W, all compounds	2E+4	3E+4	1E–5	4E–8	2E–4	2E–3
65	Terbium-156m (24.4 h)	W, all compounds	7E+3	8E+3	3E–6	1E–8	1E–4	1E–3
65	Terbium-156	W, all compounds	1E+3	1E+3	6E–7	2E–9	1E–5	1E–4
65	Terbium-157	W, all compounds	5E+4	3E+2	1E–7	—	—	—
			LLI wall (5E+4)	Bone surf (6E+2)	1E–7	—	—	—
65	Terbium-158	W, all compounds	1E+3	2E+1	8E–9	3E–11	2E–5	2E–4
65	Terbium-160	W, all compounds	8E+2	2E+2	9E–8	3E–10	1E–5	1E–4
65	Terbium-161	W, all compounds	2E+3	2E+3	7E–7	2E–9	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
			LLI wall (2E+3)	—	—	—	3E–5	3E–4
66	Dysprosium-155	W, all compounds	9E+3	3E+4	1E–5	4E–8	1E–4	1E–3
66	Dysprosium-157	W, all compounds	2E+4	6E+4	3E–5	9E–8	3E–4	3E–3
66	Dysprosium-159	W, all compounds	1E+4	2E+3	1E–6	3E–9	2E–4	2E–3
66	Dysprosium-165	W, all compounds	1E+4	5E+4	2E–5	6E–8	2E–4	2E–3
66	Dysprosium-166	W, all compounds	6E+2	7E+2	3E–7	1E–9	—	—
			LLI wall (8E+2)	—	—	—	1E–5	1E–4
67	Holmium-155[2]	W, all compounds	4E+4	2E+5	6E–5	2E–7	6E–4	6E–3
67	Holmium-157[2]	W, all compounds	3E+5	1E+6	6E–4	2E–6	4E–3	4E–2
67	Holmium-159[2]	W, all compounds	2E+5	1E+6	4E–4	1E–6	3E–3	3E–2
67	Holmium-161	W, all compounds	1E+5	4E+5	2E–4	6E–7	1E–3	1E–2
67	Holmium-162m[2]	W, all compounds	5E+4	3E+5	1E–4	4E–7	7E–4	7E–3
67	Holmium-162[2]	W, all compounds	5E+5	2E+6	1E–3	3E–6	—	—
			St. wall (8E+5)	—	—	—	1E–2	1E–1
67	Holmium-164m[2]	W, all compounds	1E+5	3E+5	1E–4	4E–7	1E–3	1E–2
67	Holmium-164[2]	W, all compounds	2E+5	6E+5	3E–4	9E–7	—	—
			St. wall (2E+5)	—	—	—	3E–3	3E–2
67	Holmium-166m	W, all compounds	6E+2	7E+0	3E–9	9E–12	9E–6	9E–5
67	Holmium-166	W, all compounds	9E+2	2E+3	7E–7	2E–9	—	—
			LLI wall (9E+2)	—	—	—	1E–5	1E–4
67	Holmium-167	W, all compounds	2E+4	6E+4	2E–5	8E–8	2E–4	2E–3
68	Erbium-161	W, all compounds	2E+4	6E+4	3E–5	9E–8	2E–4	2E–3
68	Erbium-165	W, all compounds	6E+4	2E+5	8E–5	3E–7	9E–4	9E–3
68	Erbium-169	W, all compounds	3E+3	3E+3	1E–6	4E–9	—	—
			LLI wall (4E+3)	—	—	—	5E–5	5E–4
68	Erbium-171	W, all compounds	4E+3	1E+4	4E–6	1E–8	5E–5	5E–4
68	Erbium-172	W, all compounds	1E+3	1E+3	6E–7	2E–9	—	—
			LLI wall (1E+3)	—	—	—	2E–5	2E–4
69	Thulium-162[2]	W, all compounds	7E+4	3E+5	1E–4	4E–7	—	—
			St. wall (7E+4)	—	—	—	1E–3	1E–2
69	Thulium-166	W, all compounds	4E+3	1E+4	6E–6	2E–8	6E–5	6E–4
69	Thulium-167	W, all compounds	2E+3	2E+3	8E–7	3E–9	—	—
			LLI wall (2E+3)	—	—	—	3E–5	3E–4
69	Thulium-170	W, all compounds	8E+2	2E+2	9E–8	3E–10	—	—
			LLI wall (1E+3)	—	—	—	1E–5	1E–4
69	Thulium-171	W, all compounds	1E+4	3E+2	1E–7	—	—	—
			LLI wall (1E+4)	Bone surf (6E+2)	—	8E–10	2E–4	2E–3
69	Thulium-172	W, all compounds	7E+2	1E+3	5E–7	2E–9	—	—
			LLI wall (8E+2)	—	—	—	1E–5	1E–4
69	Thulium-173	W, all compounds	4E+3	1E+4	5E–6	2E–8	6E–5	6E–4
69	Thulium-175[2]	W, all compounds	7E+4	3E+5	1E–4	4E–7	—	—
			St. wall (9E+4)	—	—	—	1E–3	1E–2
70	Ytterbium-162[2]	W, all compounds except those given for Y	7E+4	3E+5	1E–4	4E–7	1E–3	1E–2
		Y, oxides, hydroxides, and fluorides	—	3E+5	1E–4	4E–7	—	—
70	Ytterbium-166	W, see ^{162}Y	1E+3	2E+3	8E–7	3E–9	2E–5	2E–4
		Y, see ^{162}Y	—	2E+3	8E–7	3E–9	—	—
70	Ytterbium-167[2]	W, see ^{162}Y	3E+5	8E+5	3E–4	1E–6	4E–3	4E–2
		Y, see ^{162}Y	—	7E+5	3E–4	1E–6	—	—
70	Ytterbium-169	W, see ^{162}Y	2E+3	8E+2	4E–7	1E–9	2E–5	2E–4
		Y, see ^{162}Y	—	7E+2	3E–7	1E–9	—	—
70	Ytterbium-175	W, see ^{162}Y	3E+3	4E+3	1E–6	5E–9	—	—
			LLI wall (3E+3)	—	—	—	4E–5	4E–4

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
		Y, see ^{162}Y	—	3E+3	1E–6	5E–9	—	—
70	Ytterbium-177[2]	W, see ^{162}Y	2E+4	5E+4	2E–5	7E–8	2E–4	2E–3
		Y, see ^{162}Y	—	5E+4	2E–5	6E–8	—	—
70	Ytterbium-178[2]	W, see ^{162}Y	1E+4	4E+4	2E–5	6E–8	2E–4	2E–3
		Y, see ^{162}Y	—	4E+4	2E–5	5E–8	—	—
71	Lutetium-169	W, all compounds except those given for Y	3E+3	4E+3	2E–6	6E–9	3E–5	3E–4
		Y, oxides, hydroxides, and fluorides	—	4E+3	2E–6	6E–9	—	—
71	Lutetium-170	W, see ^{169}Lu	1E+3	2E+3	9E–7	3E–9	2E–5	2E–4
		Y, see ^{169}Lu	—	2E+3	8E–7	3E–9	—	—
71	Lutetium-171	W, see ^{169}Lu	2E+3	2E+3	8E–7	3E–9	3E–5	3E–4
		Y, see ^{169}Lu	—	2E+3	8E–7	3E–9	—	—
71	Lutetium-172	W, see ^{169}Lu	1E+3	1E+3	5E–4	2E–9	1E–5	1E–4
		Y, see ^{169}Lu	—	1E+3	5E–7	2E–9	—	—
71	Lutetium-173	W, see ^{169}Lu	5E+3	3E+2	1E–7	—	7E–5	7E–4
			—	Bone surf. (5E+2)	—	6E–10	—	—
		Y, see ^{169}Lu	—	3E+2	1E–7	4E–10	—	—
71	Lutetium-174m	W, see ^{169}Lu	2E+3	2E+2	1E–7	—	—	—
			LLI wall (3E+3)	Bone surf. (3E+2)	—	5E–10	4E–5	4E–4
		Y, see ^{169}Lu	—	2E+2	9E–8	3E–10	—	—
71	Lutetium-174	W, see ^{169}Lu	5E+3	1E+2	5E–8	—	7E–5	7E–4
			—	Bone surf. (2E+2)	—	3–10	—	—
		Y, see ^{169}Lu	—	2E+2	6E–8	2E–10	—	—
71	Lutetium-176m	W, see ^{169}Lu	8E+3	3E+4	1E–5	3E–8	1E–4	1E–3
		Y, see ^{169}Lu	—	2E+4	9E–6	3E–8	—	—
71	Lutetium-176	W, see ^{169}Lu	7E+2	5E+0	2E–9	—	1E–5	1E–4
			—	Bone surf. (1E+1)	—	2E–11	—	—
		Y, see ^{169}Lu	—	8E+0	3E–9	1E–11	—	—
71	Lutetium-177m	W, see ^{169}Lu	7E+2	1E+2	5E–8	—	1E–5	1E–4
			—	Bone surf. (1E+2)	—	2E–10	—	—
		Y, see ^{169}Lu	—	8E+1	3E–8	1E–10	—	—
71	Lutetium-177	W, see ^{169}Lu	2E+3	2E+3	9E–7	3E–9	—	—
			LLI wall (3E+3)	—	—	—	4E–5	4E–4
		Y, see ^{169}Lu	—	2E+3	8E–7	3E–9	—	—
71	Lutetium-178m	W, see ^{169}Lu	5E+4	2E+5	8E–5	3E–7	—	—
			St. wall (6E+4)	—	—	—	8E–4	8E–3
		Y, see ^{169}Lu	—	2E+5	7E–5	2E–7	—	—
71	Lutetium-178[2]	W, see ^{169}Lu	4E+4	1E+5	5E–5	2E–7	—	—
			St. wall (4E+4)	—	—	—	6E–4	6E–3
		Y, see ^{169}Lu	—	1E+5	5E–5	2E–7	—	—
71	Lutetium-179	W, see ^{169}Lu	6E+3	2E+4	8E–6	3E–8	9E–5	9E–4
		Y, see ^{169}Lu	—	2E+4	6E–6	3E–8	—	—
72	Hafnium-170	D, all compounds except those given for W	3E+3	6E+3	2E–6	8E–9	4E–5	4E–4
		W, oxides, hydroxides, carbides, and nitrates	—	5E+3	2E–6	6E–9	—	—
72	Hafnium-172	D, see ^{170}Hf	1E+3	9E+0	4E–9	—	2E–5	2E–4
			—	Bone surf (2E+1)	—	3E–11	—	—
		W, see ^{170}Hf	—	4E+1	2E–8	—	—	—
			—	Bone surf (6E+1)	—	8E–11	—	—
72	Hafnium-173	D, see ^{170}Hf	5E+3	1E+4	5E–6	2E–8	7E–5	7E–4
		W, see ^{170}Hf	—	1E+4	5E–6	2E–8	—	—
72	Hafnium-175	D, see ^{170}Hf	3E+3	9E+2	4E–7	—	4E–5	4E–4
			—	Bone surf (1E+3)	—	1E–9	—	—
		W, see ^{170}Hf	—	1E+3	5E–7	2E–9	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
72	Hafnium-177m[2]	D, see ^{170}Hf	2E+4	6E+4	2E–5	8E–8	3E–4	3E–3
		W, see ^{170}Hf	—	9E+4	4E–5	1E–7	—	—
72	Hafnium-178m	D, see ^{170}Hf	3E+2	1E+0	5E–10	—	3E–6	3E–5
			—	Bone surf (2E+0)	—	3E–12	—	—
		W, see ^{170}Hf	—	5E+0	2E–9	—	—	—
			—	Bone surf (9E+0)	—	1E–11	—	—
72	Hafnium-179m	D, see ^{170}Hf	1E+3	3E+2	1E–7	—	1E–5	1E–4
			—	Bone surf (6E+2)	—	8E–10	—	—
		W, see ^{170}Hf	—	6E+2	3E–7	8E–10	—	—
72	Hafnium-180m	D, see ^{170}Hf	7E+3	2E+4	9E–6	3E–8	1E–4	1E–3
		W, see ^{170}Hf	—	3E+4	1E–5	4E–8	—	—
72	Hafnium-181	D, see ^{170}Hf	1E+3	2E+2	7E–8	—	2E–5	2E–4
			—	Bone surf (4E+2)	—	6E–10	—	—
		W, see ^{170}Hf	—	4E+2	2E–7	6E–10	—	—
72	Hafnium-182m[2]	D, see ^{170}Hf	4E+4	9E+4	4E–5	1E–7	5E–4	5E–3
		W, see ^{170}Hf	—	1E+5	6E–5	2E–	—	—
72	Hafnium-182	D, see ^{170}Hf	2E+2	8E–1	3E–10	—	—	—
			Bone surf (4E+2)	Bone surf (2E+0)	—	2E–12	5E–6	5E–5
		W, see ^{170}Hf	—	3E+0	1E–9	—	—	—
			—	Bone surf (7E+0)	—	1E–11	—	—
72	Hafnium-183[2]	D, see ^{170}Hf	2E+4	5E+4	2E–5	6E–8	3E–4	3E–3
		W, see ^{170}Hf	—	6E+4	2E–5	8E–8	—	—
72	Hafnium-184	D, see ^{170}Hf	2E+3	8E+3	3E–6	1E–8	3E–5	3E–4
		W, see ^{170}Hf	—	6E+3	3E–6	9E–9	—	—
73	Tantalum-172	W, all compounds except those given for Y	4E+4	1E+5	5E–5	2E–7	5E–4	5E–3
		Y, elemental Ta, oxides, hydroxides, halides, carbides, nitrates, and nitrides	—	1E+5	4E–5	1E–7	—	—
73	Tantalum-173	W, see ^{172}Ta	7E+3	2E+4	8E–6	3E–8	9E–5	9E–4
		Y, see ^{172}Ta	—	2E+4	7E–6	2E–8	—	—
73	Tantalum-174[2]	W, see ^{172}Ta	3E+4	1E+5	4E–5	1E–7	4E–4	4E–3
		Y, see ^{172}Ta	—	9E+4	4E–5	1E–7	—	—
73	Tantalum-175	W, see ^{172}Ta	6E+3	2E+4	7E–6	2E–8	8E–5	8E–4
		Y, see ^{172}Ta	—	1E+4	6E–6	2E–8	—	—
73	Tantalum-176	W, see ^{172}Ta	4E+3	1E+4	5E–6	2E–8	5E–5	5E–4
		Y, see ^{172}Ta	—	1E+4	5E–6	2E–8	—	—
73	Tantalum-177	W, see ^{172}Ta	1E+4	2E+4	8E–6	3E–8	2E–4	2E–3
		Y, see ^{172}Ta	—	2E+4	7E–6	2E–8	—	—
73	Tantalum-178	W, see ^{172}Ta	2E+4	9E+4	4E–5	1E–7	2E–4	2E–3
		Y, see ^{172}Ta	—	7E+4	3E–5	1E–7	—	—
73	Tantalum-179	W, see ^{172}Ta	2E+4	5E+3	2E–6	8E–9	3E–4	3E–3
		Y, see ^{172}Ta	—	9E+2	4E–7	1E–9	—	—
73	Tantalum-180m	W, see ^{172}Ta	2E+4	7E+4	3E–5	9E–8	3E–4	3E–3
		Y, see ^{172}Ta	—	6E+4	2E–5	8E–8	—	—
73	Tantalum-180	W, see ^{172}Ta	1E+3	4E+2	2E–7	6E–10	2E–5	2E–4
		Y, see ^{172}Ta	—	2E+1	1E–8	3E–11	—	—
73	Tantalum182m[2]	W, see ^{172}Ta	2E+5	5E+5	2E–4	8E–7	—	—
			St. wall (2E+5)	—	—	—	3E–3	3E–2
		Y, see ^{172}Ta	—	4E+5	2E–4	6E–7	—	—
73	Tantalum-182	W, see ^{172}Ta	8E+2	3E+2	1E–7	5E–10	1E–5	1E–4
		Y, see ^{172}Ta	—	1E+2	6E–8	2E–10	—	—
73	Tantalum-183	W, see ^{172}Ta	9E+2	1E+3	5E–7	2E–9	—	—
			LLI wall (1E+3)	—	—	—	2E–5	2E–4
		Y, see ^{172}Ta	—	1E+3	4E–7	1E–9	—	—
73	Tantalum-184	W, see ^{172}Ta	2E+3	5E+3	2E–6	8E–9	3E–5	3E–4
		Y, see ^{172}Ta	—	5E+3	2E–6	7E–9	—	—
73	Tantalum-185[2]	W, see ^{172}Ta	3E+4	7E+4	3E–5	1E–7	4E–4	4E–3
		Y, see ^{172}Ta	—	6E+4	3E–5	9E–8	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
73	Tantalum-186[2]	W, see ^{172}Ta	5E+4	2E+5	1E–4	3E–7	—	—
			St. wall (7E+4)	—	—	—	1E–3	1E–2
		Y, see ^{172}Ta	—	2E+5	9E–5	3E–7	—	—
74	Tungsten-176	D, all compounds	1E+4	5E+4	2E–5	7E–8	1E–4	1E–3
74	Tungsten-177	D, all compounds	2E+4	9E+4	4E–5	1E–7	3E–4	3E–3
74	Tungsten-178	D, all compounds	5E+3	2E+4	8E–6	3E–8	7E–5	7E–4
74	Tungsten-179[2]	D, all compounds	5E+5	2E+6	7E–4	2E–6	7E–3	7E–2
74	Tungsten-181	D, all compounds	2E+4	3E+4	1E–5	5E–8	2E–4	2E–3
74	Tungsten-185	D, all compounds	2E+3	7E+3	3E–6	9E–9	—	—
			LLI wall (3E+3)	—	—	—	4E–5	4E–4
74	Tungsten-187	D, all compounds	2E+3	9E+3	4E–6	1E–8	3E–5	3E–4
74	Tungsten-188	D, all compounds	4E+2	1E+3	5E–7	2E–9	—	—
			LLI wall (5E+2)	—	—	—	7E–6	7E–5
75	Rhenium-177[2]	D, all compounds except those given for W	9E+4	3E+5	1E–4	4E–7	—	—
			St. wall (1E+5)	—	—	—	2E–3	2E–2
		W, oxides, hydroxides, and nitrates	—	4E+5	1E–4	5E–7	—	—
75	Rhenium-178[2]	D, see ^{177}Rh	7E+4	3E+5	1E–4	4E–7	—	—
			St. wall (1E+5)	—	—	—	1E–3	1E–2
		W, see ^{177}Rh	—	3E+5	1E–4	4E–7	—	—
75	Rhenium-181	D, see ^{177}Rh	5E+3	9E+3	4E–6	1E–8	7E–5	7E–4
		W, see ^{177}Rh	—	9E+3	4E–6	1E–8	—	—
75	Rhenium-182 (12.7 h)	D, see ^{177}Rh	7E+3	1E+4	5E–6	2E–8	9E–5	9E–4
		W, see ^{177}Rh	—	2E+4	6E–6	2E–8	—	—
75	Rhenium-182 (64.0 h)	D, see ^{177}Rh	1E+3	2E+3	1E–6	3E–9	2E–5	2E–4
		W, see ^{177}Rh	—	2E+3	9E–7	3E–9	—	—
75	Rhenium-184m	D, see ^{177}Rh	2E+3	3E+3	1E–6	4E–9	3E–5	3E–4
		W, see ^{177}Rh	—	4E+2	2E–7	6E–10	—	—
75	Rhenium-184	D, see ^{177}Rh	2E+3	4E+3	1E–6	5E–9	3E–5	3E–4
		W, see ^{177}Rh	—	1E+3	6E–7	2E–9	—	—
75	Rhenium-186m	D, see ^{177}Rh	1E+3	2E+3	7E–7	—	—	—
			St. wall (2E+3)	St. wall (2E+3)	—	3E–9	2E–5	2E–4
		W, see ^{177}Rh	—	2E+2	6E–8	2E–10	—	—
75	Rhenium-186	D, see ^{177}Rh	2E+3	3E+3	1E–6	4E–9	3E–5	3E–4
		W, see ^{177}Rh	—	2E+3	7E–7	2E–9	—	—
75	Rhenium-187	D, see ^{177}Rh	6E+5	8E+5	4E–4	—	8E–3	8E–2
			—	St. wall (9E+5)	—	1E–6	—	—
		W, see ^{177}Rh	—	1E+5	4E–5	1E–7	—	—
75	Rhenium-188m[2]	D, see ^{177}Rh	8E+4	1E+5	6E–5	2E–7	1E–3	1E–2
		W, see ^{177}Rh	—	1E+5	6E–5	2E–7	—	—
75	Rhenium-188	D, see ^{177}Rh	2E+3	3E+3	1E–6	4E–9	2E–5	2E–4
		W, see ^{177}Rh	—	3E+3	1E–6	4E–9	—	—
75	Rhenium-189	D, see ^{177}Rh	3E+3	5E+3	2E–6	7E–9	4E–5	4E–4
		W, see ^{177}Rh	—	4E+3	2E–6	6E–9	—	—
76	Osmium-180[2]	D, all compounds except those given for W and Y	1E+5	4E+5	2E–4	5E–7	1E–3	1E–2
		W, halides and nitrates	—	5E+5	2E–4	7E–7	—	—
76	Osmium-181[2]	D, see ^{180}Os	1E+4	4E+4	2E–5	6E–8	2E–4	2E–3
		W, see ^{180}Os	—	5E+4	2E–5	6E–8	—	—
		Y, see ^{180}Os	—	4E+4	2E–5	6E–8	—	—
76	Osmium-182	D, see ^{180}Os	2E+3	6E+3	2E–6	8E–9	3E–5	3E–4
		W, see ^{180}Os	—	4E+3	2E–6	6E–9	—	—
		Y, see ^{180}Os	—	4E+3	2E–6	6E–9	—	—
76	Osmium-185	D, see ^{180}Os	2E+3	5E+2	2E–7	7E–10	3E–5	3E–4
		W, see ^{180}Os	—	8E+2	3E–7	1E–9	—	—
		Y, see ^{180}Os	—	8E+2	3E–7	1E–9	—	—
76	Osmium-189m	D, see ^{180}Os	8E+4	2E+5	1E–4	3E–7	1E–3	1E–2
		W, see ^{180}Os	—	2E+5	9E–5	3E–7	—	—
		Y, see ^{180}Os	—	2E+5	7E–5	2E–7	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
76	Osmium-191m	D, see ^{180}Os	1E+4	3E+4	1E–5	4E–8	2E–4	2E–3
		W, see ^{180}Os	—	2E+4	8E–6	3E–8	—	—
		Y, see ^{180}Os	—	2E+4	7E–6	2E–8	—	—
76	Osmium-191	D, see ^{180}Os	2E+3	2E+3	9E–7	3E–9	—	—
			LLI wall (3E+3)	—	—	—	3E–5	3E–4
		W, see ^{180}Os	—	2E+3	7E–7	2E–9	—	—
		Y, see ^{180}Os	—	1E+3	6E–7	2E–9	—	—
76	Osmium-193	D, see ^{180}Os	2E+3	5E+3	2E–6	6E–9	—	—
			LLI wall (2E+3)	—	—	—	2E–5	2E–4
		W, see ^{180}Os	—	3E+3	1E–6	4E–9	—	—
		Y, see ^{180}Os	—	3E+3	1E–6	4E–9	—	—
76	Osmium-194	D, see ^{180}Os	4E+2	4E+1	2E–8	6E–11	—	—
			LLI wall (6E+2)	—	—	—	8E–6	8E–5
		W, see ^{180}Os	—	6E+1	2E–8	8E–11	—	—
		Y, see ^{180}Os	—	8E+0	3E–9	1E–11	—	—
77	Iridium--182[2]	D, all compounds except those given for W and Y	4E+4	1E+5	6E–5	2E–7	—	—
			St. wall (4E+4)	—	—	—	6E–4	6E–3
		W, halides, nitrates, and metallic iridium	—	2E+5	6E–5	2E–7	—	—
		Y, oxides and hydroxides	—	1E+5	5E–5	2E–7	—	—
77	Iridium-184	D, see ^{182}Ir	8E+3	2E+4	1E–5	3E–8	1E–4	1E–3
		W, see ^{182}Ir	—	3E+4	1E–5	5E–8	—	—
		Y, see ^{182}Ir	—	3E+4	1E–5	4E–8	—	—
77	Iridium-185	D, see ^{182}Ir	5E+3	1E+4	5E–6	2E–8	7E–5	7E–4
		W, see ^{182}Ir	—	1E+4	5E–6	2E–8	—	—
		Y, see ^{182}Ir	—	1E+4	4E–6	1E–8	—	—
77	Iridium-186	D, see ^{182}Ir	2E+3	8E+3	3E–6	1E–8	3E–5	3E–4
		W, see ^{182}Ir	—	6E+3	3E–6	9E–9	—	—
		Y, see ^{182}Ir	—	6E+3	2E–6	8E–9	—	—
77	Iridium-187	D, see ^{182}Ir	1E+4	3E+4	1E–5	5E–8	1E–4	1E–3
		W, see ^{182}Ir	—	3E+4	1E–5	4E–8	—	—
		Y, see ^{182}Ir	—	3E+4	1E–5	4E–8	—	—
77	Iridium-188	D, see ^{182}Ir	2E+3	5E+3	2E–6	6E–9	3E–5	3E–4
		W, see ^{182}Ir	—	4E+3	1E–6	5E–9	—	—
		Y, see ^{182}Ir	—	3E+3	1E–6	5E–9	—	—
77	Iridium-189	D, see ^{182}Ir	5E+3	5E+3	2E–6	7E–9	—	—
			LLI wall (5E+3)	—	—	—	7E–5	7E–4
		W, see ^{182}Ir	—	4E+3	2E–6	5E–9	—	—
		Y, see ^{182}Ir	—	4E+3	1E–6	5E–9	—	—
77	Iridium-190m[2]	D, see ^{182}Ir	2E+5	2E+5	8E–5	3E–7	2E–3	2E–2
		W, see ^{182}Ir	—	2E+5	9E–5	3E–7	—	—
		Y, see ^{182}Ir	—	2E+5	8E–5	3E–7	—	—
77	Iridium-190	D, see ^{182}Ir	1E+3	9E+2	4E–7	1E–9	1E–5	1E–4
		W, see ^{182}Ir	—	1E+3	4E–7	1E–9	—	—
		Y, see ^{182}Ir	—	9E+2	4E–7	1E–9	—	—
77	Iridium-192m	D, see ^{182}Ir	3E+3	9E+1	4E–8	1E–10	4E–5	4E–4
		W, see ^{182}Ir	—	2E+2	9E–8	3E–10	—	—
		Y, see ^{182}Ir	—	2E+1	6E–9	2E–11	—	—
77	Iridium-192	D, see ^{182}Ir	9E+2	3E+2	1E–7	4E–10	1E–5	1E–4
		W, see ^{182}Ir	—	4E+2	2E–7	6E–10	—	—
		Y, see ^{182}Ir	—	2E+2	9E–8	3E–10	—	—
77	Iridium-194m	D, see ^{182}Ir	6E+2	9E+1	4E–8	1E–10	9E–6	9E–5
		W, see ^{182}Ir	—	2E+2	7E–8	2E–10	—	—
		Y, see ^{182}Ir	—	1E+2	4E–8	1E–10	—	—
77	Iridium-194	D, see ^{182}Ir	1E+3	3E+3	1E–6	4E–9	1E–5	1E–4
		W, see ^{182}Ir	—	2E+3	9E–7	3E–9	—	—
		Y, see ^{182}Ir	—	2E+3	8E–7	3E–9	—	—
77	Iridium-195m	D, see ^{182}Ir	8E+3	2E+4	1E–5	3E–8	1E–4	1E–3
		W, see ^{182}Ir	—	3E+4	1E–5	4E–8	—	—
		Y, see ^{182}Ir	—	2E+4	9E–6	3E–8	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
77	Iridium-195	D, see ^{182}Ir	1E+4	4E+4	2E–5	6E–8	2E–4	2E–3
		W, see ^{182}Ir	—	5E+4	2E–5	7E–8	—	—
		Y, see ^{182}Ir	—	4E+4	2E–5	6E–8	—	—
78	Platinum-186	D, all compounds	1E+4	4E+4	2E–5	5E–8	2E–4	2E–3
78	Platinum-188	D, all compounds	2E+3	2E+3	7E–7	2E–9	2E–5	2E–4
78	Platinum-189	D, all compounds	1E+4	3E+4	1E–5	4E–8	1E–4	1E–3
78	Platinum-191	D, all compounds	4E+3	8E+3	4E–6	1E–8	5E–5	5E–4
78	Platinum-193m	D, all compounds	3E+3	6E+3	3E–6	8E–9	—	—
			LLI wall (3E+4)	—	—	—	4E–5	4E–4
78	Platinum-193	D, all compounds	4E+4	2E+4	1E–5	3E–8	—	—
			LLI wall (5E+4)	—	—	—	6E–4	6E–3
78	Platinum-195m	D, all compounds	2E+3	4E+3	2E–6	6E–9	—	—
			LLI wall (2E+3)	—	—	—	3E–5	3E–4
78	Platinum-197m[2]	D, all compounds	2E+4	4E+4	2E–5	6E–8	2E–4	2E–3
78	Platinum-197	D, all compounds	3E+3	1E+4	4E–6	1E–8	4E–5	4E–4
78	Platinum-199[2]	D, all compounds	5E+4	1E+5	6E–5	2E–7	7E–4	7E–3
78	Platinum-200	D, all compounds	1E+3	3E+3	1E–6	5E–9	2E–5	2E–4
79	Gold-193	D, all compounds except those given for W and Y	9E+3	3E+4	1E–5	4E–8	1E–4	1E–3
		W, halides and nitrates	—	2E+4	9E–6	3E–8	—	—
		Y, oxides and hydroxides	—	2E+4	8E–6	3E–8	—	—
79	Gold-194	D, see ^{193}Au	3E+3	8E+3	3E–6	1E–8	4E–5	4E–4
		W, see ^{193}Au	—	5E+3	2E–6	8E–9	—	—
		Y, see ^{193}Au	—	5E+3	2E–6	7E–9	—	—
79	Gold-195	D, see ^{193}Au	5E+3	1E+4	5E–6	2E–8	7E–5	7E–4
		W, see ^{193}Au	—	1E+3	6E–7	2E–9	—	—
		Y, see ^{193}Au	—	4E+2	2E–7	6E–10	—	—
79	Gold-198m	D, see ^{193}Au	1E+3	3E+3	1E–6	4E–9	1E–5	1E–4
		W, see ^{193}Au	—	1E+3	5E–7	2E–9	—	—
		Y, see ^{193}Au	—	1E+3	5E–7	2E–9	—	—
79	Gold-198	D, see ^{193}Au	1E+3	4E+3	2E–6	5E–9	2E–5	2E–4
		W, see ^{193}Au	—	2E+3	8E–7	3E–9	—	—
		Y, see ^{193}Au	—	2E+3	7E–7	2E–9	—	—
79	Gold-199	D, see ^{193}Au	3E+3	9E+3	4E–6	1E–8	—	—
			LLI wall (3E+3)	—	—	—	4E–5	4E–4
		W, see ^{193}Au	—	4E+3	2E–6	6E–9	—	—
		Y, see ^{193}Au	—	4E+3	2E–6	5E–9	—	—
79	Gold-200m	D, see ^{193}Au	1E+3	4E+3	1E–6	5E–9	2E–5	2E–4
		W, see ^{193}Au	—	3E+3	1E–6	4E–9	—	—
		Y, see ^{193}Au	—	2E+4	1E–6	3E–9	—	—
79	Gold-200[2]	D, see ^{193}Au	3E+4	6E+4	3E–5	9E–8	4E–4	4E–3
		W, see ^{193}Au	—	8E+4	3E–5	1E–7	—	—
		Y, see ^{193}Au	—	7E+4	3E–5	1E–7	—	—
79	Gold-201[2]	D, see ^{193}Au	7E+4	2E+5	9E–5	3E–7	—	—
			St. wall (9E+4)	—	—	—	1E–3	1E–2
		W, see ^{193}Au	—	2E+5	1E–4	3E–7	—	—
		Y, see ^{193}Au	—	2E+5	9E–5	3E–7	—	—
80	Mercury-193m	Vapor	—	8E+3	4E–6	1E–8	—	—
		Organic D	4E+3	1E+4	5E–6	2E–8	6E–5	6E–4
		D, sulfates	3E+3	9E+3	4E–6	1E–8	4E–5	4E–4
		W, oxides, hydroxides, halides, nitrates, and sulfides	—	8E+3	3E–6	1E–8	—	—
80	Mercury-193	Vapor	—	3E+4	1E–5	4E–8	—	—
		Organic D	2E+4	6E+4	3E–5	9E–8	3E–4	3E–3
		D, see ^{193m}Hg	2E+4	4E+4	2E–5	6E–8	2E–4	2E–3
		W, see ^{193m}Hg	—	4E+4	2E–5	6E–8	—	—
80	Mercury-194	Vapor	—	3E+1	1E–8	4E–11	—	—
		Organic D	2E+1	3E+1	1E–8	4E–11	2E–7	2E–6
		D, see ^{193m}Hg	8E+2	4E+1	2E–8	6E–11	1E–5	1E–4
		W, see ^{193m}Hg	—	1E+2	5E–8	2E–10	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
80	Mercury-195m	Vapor	—	4E+3	2E–6	6E–9	—	—
		Organic D	3E+3	6E+3	3E–6	8E–9	4E–5	4E–4
		D, see ^{193m}Hg	2E+3	5E+3	2E–6	7E–9	3E–5	3E–4
		W, see ^{193m}Hg	—	4E+3	2E–6	5E–9	—	—
80	Mercury-195	Vapor	—	3E+4	1E–5	4E–8	—	—
		Organic D	2E+4	5E+4	2E–5	6E–8	2E–4	2E–3
		D, see ^{193m}Hg	1E+4	4E+4	1E–5	5E–8	2E–4	2E–3
		W, see ^{193m}Hg	—	3E+4	1E–5	5E–8	—	—
80	Mercury-197m	Vapor	—	5E+3	2E–6	7E–9	—	—
		Organic D	9E+3	4E–6	1E–8	5E–5	5E–4	3E–3
		D, see ^{193m}Hg	3E+3	7E+3	3E–6	1E–8	4E–5	4E–4
		W, see ^{193m}Hg	—	5E+3	2E–6	7E–9	—	—
80	Mercury-197	Vapor	—	8E+3	4E–6	1E–8	—	—
		Organic D	7E+3	1E+4	6E–6	2E–8	9E–5	9E–4
		D, see ^{193m}Hg	6E+3	1E+4	5E–6	2E–8	8E–5	8E–4
		W, see ^{193m}Hg	—	9E+3	4E–6	1E–8	—	—
80	Mercury-199m[2]	Vapor	—	8E+4	3E–5	1E–7	—	—
		Organic D	6E+4	2E+5	7E–5	2E–7	—	—
			St. wall (1E+5)	—	—	—	1E–3	1E–2
		D, see ^{193m}Hg	6E+4	1E+5	6E–5	2E–7	8E–4	8E–3
		W, see ^{193m}Hg	—	2E+5	7E–5	2E–7	—	—
80	Mercury-203	Vapor	—	8E+2	4E–7	1E–9	—	—
		Organic D	5E+2	8E+2	3E–7	1E–9	7E–6	7E–5
		D, see ^{193m}Hg	2E+3	1E+3	5E–7	2E–9	3E–5	3E–4
		W, see ^{193m}Hg	—	1E+3	5E–7	2E–9	—	—
81	Thallium-194m[2]	D, all compounds	5E+4	2E+5	6E–5	2E–7	—	—
			St. wall (7E+4)	—	—	—	1E–3	1E–2
81	Thallium-194[2]	D, all compounds	3E+5	6E+5	2E–4	8E–7	—	—
			St. wall (3E+5)	—	—	—	4E–3	4E–2
81	Thallium-195[2]	D, all compounds	6E+4	1E+5	5E–5	2E–7	9E–4	9E–3
81	Thallium-197	D, all compounds	7E+4	1E+5	5E–5	2E–7	1E–3	1E–2
81	Thallium-198m[2]	D, all compounds	3E+4	5E+4	2E–5	8E–8	4E–4	4E–3
81	Thallium-198	D, all compounds	2E+4	3E+4	1E–5	5E–8	3E–4	3E–3
81	Thallium-199	D, all compounds	6E+4	8E+4	4E–5	1E–7	9E–4	9E–3
81	Thallium-200	D, all compounds	8E+3	1E+4	5E–6	2E–8	1E–4	1E–3
81	Thallium-201	D, all compounds	2E+4	2E+4	9E–6	3E–8	2E–4	2E–3
81	Thallium-202	D, all compounds	4E+3	5E+3	2E–6	7E–9	5E–5	5E–4
81	Thallium-204	D, all compounds	2E+3	2E+3	9E–7	3E–9	2E–5	2E–4
82	Lead-195m[2]	D, all compounds	6E+4	2E+5	8E–5	3E–7	8E–4	8E–3
82	Lead-198	D, all compounds	3E+4	6E+4	3E–5	9E–8	4E–4	4E–3
82	Lead-199[2]	D, all compounds	2E+4	7E+4	3E–5	1E–7	3E–4	3E–3
82	Lead-200	D, all compounds	3E+3	6E+3	3E–6	9E–9	4E–5	4E–4
82	Lead-201	D, all compounds	7E+3	2E+4	8E–6	3E–8	1E–4	1E–3
82	Lead-202m	D, all compounds	9E+3	3E+4	1E–5	4E–8	1E–4	1E–3
82	Lead-202	D, all compounds	1E+2	5E+1	2E–8	7E–11	2E–6	2E–5
82	Lead-203	D, all compounds	5E+3	9E+3	4E–6	1E–8	7E–5	7E–4
82	Lead-205	D, all compounds	4E+3	1E+3	6E–7	2E–9	5E–5	5E–4
82	Lead-209	D, all compounds	2E+4	6E+4	2E–5	8E–8	3E–4	3E–3
82	Lead-210	D, all compounds	6E–1	2E–1	1E–10	—	—	—
			Bone surf (1E+0)	Bone surf (4E–1)	—	6E–13	1E–8	1E–7
82	Lead-211[2]	D, all compounds	1E+4	6E+2	3E–7	9E–10	2E–4	2E–3
82	Lead-212	D, all compounds	8E+1	3E+1	1E–8	5E–11	—	—
			Bone surf (1E+2)	—	—	—	2E–6	2E–5
82	Lead-214[2]	D, all compounds	9E+3	8E+2	3E–7	1E–9	1E–4	1E–3
83	Bismuth-200[2]	D, nitrates	3E+4	8E+4	4E–5	1E–7	4E–4	4E–3
		W, all other compounds	—	1E+5	4E–5	1E–7	—	—
83	Bismuth-201[2]	D, see ^{200}Bi	1E+4	3E+4	1E–5	4E–8	2E–4	2E–3
		W, see ^{200}Bi	—	4E+4	2E–5	5E–8	—	—
83	Bismuth-202[2]	D, see ^{200}Bi	1E+4	4E+4	2E–5	6E–8	2E–4	2E–3
		W, see ^{200}Bi	—	8E+4	3E–5	1E–7	—	—
83	Bismuth-203	D, see ^{200}Bi	2E+3	7E+3	3E–6	9E–9	3E–5	3E–4
		W, see ^{200}Bi	—	6E+3	3E–6	9E–9	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
83	Bismuth-205	D, see ^{200}Bi	1E+3	3E+3	1E–6	3E–9	2E–5	2E–4
		W, see ^{200}Bi	—	1E+3	5E–7	2E–9	—	—
83	Bismuth-206	D, see ^{200}Bi	6E+2	1E+3	6E–7	2E–9	9E–6	9E–5
		W, see ^{200}Bi	—	9E+2	4E–7	1E–9	—	—
83	Bismuth-207	D, see ^{200}Bi	1E+3	2E+3	7E–7	2E–9	1E–5	1E–4
		W, see ^{200}Bi	—	4E+2	1E–7	5E–10	—	—
83	Bismuth-210m	D, see ^{200}Bi	4E+1 Kidneys (6E+1)	5E+0 Kidneys (6E+0)	2E–9 —	— 9E–12	— 8E–7	— 8E–6
		W, see ^{200}Bi	—	7E–1	3E–10	9E–13	—	—
83	Bismuth-210	D, see ^{200}Bi	8E+2 —	2E+2 Kidneys (4E+2)	1E–7 —	— 5E–10	1E–5 —	1E–4 —
		W, see ^{200}Bi	—	3E+1	1E–8	4E–11	—	—
83	Bismuth-212[2]	D, see ^{200}Bi	5E+3	2E+2	1E–7	3E–10	7E–5	7E–4
		W, see ^{200}Bi	—	3E+2	1E–7	4E–10	—	—
83	Bismuth-213[2]	D, see ^{200}Bi	7E+3	3E+2	1E–7	4E–10	1E–4	1E–3
		W, see ^{200}Bi	—	4E+2	1E–7	5E–10	—	—
83	Bismuth-214[2]	D, see ^{200}Bi	2E+4 St. wall (2E+4)	8E+2 —	3E–7 —	1E–9 —	— 3E–4	— 3E–3
		W, see ^{200}Bi	—	9E–2	4E–7	1E–9	—	—
84	Polonium-203[2]	D, all compounds except those given for W	3E+4	6E+4	3E–5	9E–8	3E–4	3E–3
		W, oxides, hydroxides and nitrates	—	9E+4	4E–5	1E–7	—	—
84	Polonium-205[2]	D, see ^{203}Po	2E+4	4E+4	2E–5	5E–8	3E–4	3E–3
		W, see ^{203}Po	—	7E+4	3E–5	1E–7	—	—
84	Polonium-207	D, see ^{203}Po	8E+3	3E+4	1E–5	3E–8	1E–4	1E–3
		W, see ^{203}Po	—	3E–4	1E–5	4E–8	—	—
84	Polonium-210	D, see ^{203}Po	3E+0	6E–1	3E–10	9E–13	4E–8	4E–7
		W, see ^{203}Po	—	6E–1	3E–10	9E–13	—	—
85	Astatine-207[2]	D, halides	6E+3	3E+3	1E–6	4E–9	8E–5	8E–4
		W	—	2E+3	9E–7	3E–9	—	—
85	Astatine-211	D, halides	1E+2	8E+1	3E–8	1E–10	2E–6	2E–5
		W	—	5E+1	2E–8	8E–11	—	—
86	Radon-220	With daughters removed	—	2E+4	7E–6	2E–8	—	—
		With daughters present	—	2E+1 (or 12 working level months)	9E–9 (or 1.0 working level	3E–11	—	—
86	Radon-222	With daughters removed	—	1E+4	4E–6	1E–8	—	—
		With daughters present	—	1E+2 (or 4 working level months)	3E–8 (or 0.33 working level)	1E–10	—	—
87	Francium-222[2]	D, all compounds	2E+3	5E+2	2E–7	6E–10	3E–5	3E–4
87	Francium-223[2]	D, all compounds	6E+2	8E+2	3E–7	1E–9	8E–6	8E–5
88	Radium-223	W, all compounds	5E+0 Bone surf (9E+0)	7E–1 —	3E–10 —	9E–13 —	— 1E–7	— 1E–6
88	Radium-224	W, all compounds	8E+0 Bone surf (2E+1)	2E+0 —	7E–10 —	2E–12 —	— 2E–7	— 2E–6
88	Radium-225	W, all compounds	8E+0 Bone surf (2E+1)	7E–1 —	3E–10 —	9E–13 —	— 2E–7	— 2E–6
88	Radium-226	W, all compounds	2E+0 Bone surf (5E+0)	6E–1 —	3E–10 —	9E–13 —	— 6E–8	— 6E–7
88	Radium-227[2]	W, all compounds	2E+4 Bone surf (2E+4)	1E+4 Bone surf (2E+4)	6E–6 —	— 3E–8	— 3E–4	— 3E–3
88	Radium-228	W, all compounds	2E+0 Bone surf (4E+0)	1E+0 —	5E–10 —	2E–12 —	— 6E–8	— 6E–7
89	Actinium-224	D, all compounds except those given for W and Y	2E+3	3E+1	1E–8	—	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
		W, halides and nitrates	—	5E+1	2E–8	7E–11	—	—
		Y, oxides and hydroxides	—	5E+1	2E–8	6E–11	—	—
89	Actinium-225	D, see ^{224}Ac	5E+1	3E–1	1E–10	—	—	—
			LLI wall (5E+1)	Bone surf (5E–1)	—	7E–13	7E–7	7E–6
		W, see ^{224}Ac	—	6E–1	3E–10	9E–13	—	—
		Y, see ^{224}Ac	—	6E–1	3E–10	9E–13	—	—
89	Actinium-226	D, see ^{224}Ac	1E+2	3E+0	1E–9	—	—	—
			LLI wall (1E+2)	Bone surf (4E+0)	—	5E-12	2E–6	2E–5
		W, see ^{224}Ac	—	5E+0	2E–9	7E–12	—	—
		Y, see ^{224}Ac	—	5E+0	2E–9	6E–12	—	—
89	Actinium-227	D, see ^{224}Ac	2E–1	4E–4	2E–13	—	—	—
			Bone surf (4E_1)	Bone surf (8E-4)	—	1E–15	5E–9	5E–8
		W, see ^{224}Ac	—	2E–3	7E–13	—	—	—
			—	Bone surf (3E–3)	—	4E–15	—	—
		Y, see ^{224}Ac	—	4E–3	2E–12	6E–15	—	—
89	Actinium-228	D, see ^{224}Ac	2E+3	9E+0	4E–9	—	3E–5	3E–4
			—	Bone surf (2E+1)	—	2E–11	—	—
		W, see ^{224}Ac	—	4E+1	—	2E–11	—	—
			—	Bone surf (6E+1)	—	8E–11	—	—
		Y, see ^{224}Ac	—	4E+1	2E–8	6E–11	—	—
90	Thorium-226[2]	W, all compounds except those given for Y	5E+3	2E+2	6E–8	2E–10	—	—
			St. Wall (5E+3)	—	—	—	7E–5	7E–4
		Y, oxides and hydroxides	—	1E+2	6E–8	2E–10	—	—
90	Thorium-227	W, see ^{226}Th	1E+2	3E–1	1E–10	5E–13	2E–6	2E–5
		Y, see ^{226}Th	—	3E–1	1E–10	5E–13	—	—
90	Thorium-228	W, see ^{226}Th	6E+0	1E–2	4E–12	—	—	—
			Bone surf (1E+1)	Bone surf (2E–2)	—	3E–14	2E–7	2E–6
		Y, see ^{226}Th	—	2E–2	7E–12	2E–14	—	—
90	Thorium-229	W, see ^{226}Th	6E–1	9E–4	4E–13	—	—	—
			Bone surf (1E+0)	Bone surf (2E–3)	—	3E–15	2E–8	2E–7
		Y, see ^{226}Th	—	2E–3	1E–12	—	—	—
			—	Bone surf (3E–3)	—	4E–15	—	—
90	Thorium-230	W, see ^{226}Th	4E+0	6E–3	3E–12	—	—	—
			Bone surf (9E+0)	Bone surf (2E–2)	—	2E–14	1E–7	1E–6
		Y, see ^{226}Th	—	2E–2	6E–12	—	—	—
			—	Bone surf (2E–2)	—	3E–14	—	—
90	Thorium-231	W, see ^{226}Th	4E+3	6E+3	3E–6	9E–9	5E–5	5E–4
		Y, see ^{226}Th	—	6E+3	3E–6	9E–9	—	—
90	Thorium-232	W, see ^{226}Th	7E–1	1E–3	5E–13	—	—	—
			Bone surf (2E+0)	Bone surf (3E–3)	—	4E–15	3E–8	3E–7
		Y, see ^{226}Th	—	3E–3	1E–12	—	—	—
			—	Bone surf (4E–3)	—	6E–15	—	—
90	Thorium-234	W, see ^{226}Th	3E+2	2E+2	8E–8	3E–10	—	—
			LLI wall (4E+2)	—	—	—	5E–6	5E–5
		Y, see ^{226}Th	—	2E+2	6E–8	2E–10	—	—
91	Protactinium-227[2]	W, all compounds except those given for Y	4E+3	1E+2	5E–8	2E–10	5E–5	5E–4
		Y, oxides and hydroxides	—	1E+2	4E–8	1E–10	—	—
91	Protactinium-228	W, see ^{227}Pa	4E+3	1E+2	5E–8	2E–10	5E–5	5E–4
			—	Bone surf (2E+1)	—	3E–11	—	—
		Y, see ^{227}Pa	—	1E+1	5E–9	2E–11	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
91	Protactinium-230	W, see ^{227}Pa	6E+2	5E+0	2E–9	7E–12	—	—
			Bone surf (9E+2)	—	—	—	1E–5	1E–4
		Y, see ^{227}Pa	—	4E+0	1E–9	5E–12	—	—
91	Protactinium-231	W, see ^{227}Pa	2E–1	2E–3	6E–13	—	—	—
			Bone surf (5E–1)	Bone surf (4E–3)	—	6E–15	6–E9	6E–8
		Y, see ^{227}Pa	—	4E–3	2E–12	—	—	—
			—	Bone surf (6E–3)	—	8E–15	—	—
91	Protactinium-232	W, see ^{227}Pa	1E+3	2E+1	9E–9	—	2E–5	2E–4
			—	Bone surf (6E+1)	—	8E–11	—	—
		Y, see ^{227}Pa	—	6E+1	2E–8	—	—	—
			—	Bone surf (7E+1)	—	1E–10	—	—
91	Protactinium-233	W, see ^{227}Pa	1E+3	7E+2	3E–7	1E–9	—	—
			LLI wall (2E+3)	—	—	—	2E–5	2E–4
		Y, see ^{227}Pa	—	6E+2	2E–7	8E–10	—	—
91	Protactinium-234	W, see ^{227}Pa	2E+3	8E+3	3E–6	1E–8	3E–5	3E–4
		Y, see ^{227}Pa	—	7E+3	3E–6	9E–9	—	—
92	Uranium-230	D, UF_6, UO_2F_2, $UO_2(NO_3)_2$	4E+0	4E–1	2E–10	—	—	—
			Bone surf (4E+0)	Bone surf (6E–1)	—	8E–13	8E–8	8E–7
		W, UO_3, UF_4, UCl_4	—	4E–1	1E–10	5E–13	—	—
		Y, UO_2, U_3O_8	—	3E–1	1E–10	4E–13	—	—
92	Uranium-231	D, see ^{230}U	5E+3	8E+3	3E–6	1E–8	—	—
			LLI wall (4E+3)	—	—	—	6E–5	6E–4
		W, see ^{230}U	—	6E+3	2E–6	8E–9	—	—
		Y, see ^{230}U	—	5E+3	2E–6	6E–9	—	—
92	Uranium-232	D, see ^{230}U	2E+0	2E–1	9E–11	—	—	—
			Bone surf (4E+0)	Bone surf (4E–1)	—	6E–13	6E–8	6E–7
		W, see ^{230}U	—	4E–1	2E–10	5E–13	—	—
		Y, see ^{230}U	—	8E–3	3E–12	1E–14	—	—
92	Uranium-233	D, see ^{230}U	1E+1	1E+0	5E–10	—	—	—
			Bone surf (2E+1)	Bone surf (2E+0)	—	3E–12	3E–7	3E–6
		W, see ^{230}U	—	7E–1	3E–10	1E–12	—	—
		Y, see ^{230}U	—	4E–2	2E–11	5E–14	—	—
92	Uranium-234[3]	D, see ^{230}U	1E+1	1E+0	5E–10	—	—	—
			Bone surf (2E+1)	Bone surf (2E+0)	—	3E–12	3E–7	3E–6
		W, see ^{230}U	—	7E–1	3E–10	1E–12	—	—
		Y, see ^{230}U	—	4E–2	2E–11	5E–14	—	—
92	Uranium-235[3]	D, see ^{230}U	1E+1	1E+0	6E–10	—	—	—
			Bone surf (2E+1)	Bone surf (2E+0)	—	3E–12	3E–7	3E–6
		W, see ^{230}U	—	8E–1	3E–10	1E–12	—	—
		Y, see ^{230}U	—	4E–2	2E–11	6E–14	—	—
92	Uranium-236	D, see ^{230}U	1E+1	1E+0	5E–10	—	—	—
			Bone surf (2E+1)	Bone surf (2E+0)	—	3E–12	3E–7	3E–6
		W, see ^{230}U	—	8E–1	3E–10	1E–12	—	—
		Y, see ^{230}U	—	4E–2	2E–11	6E–14	—	—
92	Uranium-237	D, see ^{230}U	2E+3	3E+3	1E–6	4E–9	—	—
			LLI wall (2E+3)	—	—	—	3E–5	3E–4
		W, see ^{230}U	—	2E+3	7E–7	2E–9	—	—
		Y, see ^{230}U	—	2E+3	6E–7	2E–9	—	—
92	Uranium-238[3]	D, see ^{230}U	1E+1	1E+0	6E–10	—	—	—
			Bone surf (2E+1)	Bone surf (2E+0)	—	3E–12	3E–7	3E–6
		W, see ^{230}U	—	8E–1	3E–10	1E–12	—	—
		Y, see ^{230}U	—	4E–2	2E–11	6E–14	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
92	Uranium-239[2]	D, see ^{230}U	7E+4	2E+5	8E–5	3E–7	9E–4	9E–3
		W, see ^{230}U	—	2E+5	7E–5	2E–7	—	—
		Y, see ^{230}U	—	2E+5	6E–5	2E–7	—	—
92	Uranium-240	D, see ^{230}U	1E+3	4E+3	2E–6	5E–9	2E–5	2E–4
		W, see ^{230}U	—	3E+3	1E–6	4E–9	—	—
		Y, see ^{230}U	—	2E+3	1E–6	3E–9	—	—
92	Uranium-natural[3]	D, see ^{230}U	1E+1	1E+0	5E–10	—	—	—
			Bone surf (2E+1)	Bone surf (2E+0)	—	3E–12	3E–7	3E–6
		W, see ^{230}U	—	8E–1	3E–10	9E–13	—	—
		Y, see ^{230}U	—	5E–2	2E–11	9E–14	—	—
93	Neptunium-232[2]	W, all compounds	1E+5	2E+3	7E–7	—	2E–3	2E–2
			—	Bone surf (5E+2)	—	6E–9	—	—
93	Neptunium-233[2]	W, all compounds	8E+5	3E+6	1E–3	4E–6	1E–2	1E–1
93	Neptunium-234	W, all compounds	2E+3	3E+3	1E–6	4E–9	3E–5	3E–4
93	Neptunium-235	W, all compounds	2E+4	8E+2	3E–7	—	—	—
			LLI wall (2E+4)	Bone surf (1E+3)	—	2E–9	3E–4	3E–3
93	Neptunium-236 (1.15E+5 y)	W, all compounds	3E+0	2E–2	9E–12	—	—	—
			Bone surf (6E+0)	Bone surf (5E–2)	—	8E–14	9E–8	9E–7
93	Neptunium-236m (22.5 h)	W, all compounds	3E+3	3E+1	1E–8	—	—	—
			Bone surf (4E+3)	Bone surf (7E+1)	—	1E–10	5E–5	5E–4
93	Neptunium-237	W, all compounds	5E–1	4E–3	2E–12	—	—	—
			Bone surf (1E+0)	Bone surf (1E–2)	—	1E–14	2E–8	2E–7
93	Neptunium-238	W, all compounds	1E+3	6E+1	3E–8	—	2E–5	2E–4
			—	Bone surf (2E+2)	—	2E–10	—	—
93	Neptunium-239	W, all compounds	2E+3	2E+3	9E–7	3E–9	—	—
			LLI wall (2E+3)	—	—	—	2E–5	2E–4
93	Neptunium-240[2]	W, all compounds	2E+4	8E+4	3E–5	1E–7	3E–4	3E–3
94	Plutonium-234	W, all compounds except PuO_2	8E+3	2E+2	9E–8	3E–10	1E–4	1E–3
		Y, PuO_2	—	2E+2	8E–8	3E–10	—	—
94	Plutonium-235[2]	W, see ^{234}Pu	9E+5	3E+6	1E–3	4E–6	1E–2	1E–1
		Y, see ^{234}Pu	—	3E+6	1E–3	3E–6	—	—
94	Plutonium-236	W, see ^{234}Pu	2E+0	2E–2	8E–12	—	—	—
			Bone surf (4E+0)	Bone surf 4E–2)	—	5E–14	6E–8	6E–7
		Y, see ^{234}Pu	—	4E–2	2E–11	6E–14	—	—
94	Plutonium-237	W, see ^{234}Pu	1E+4	3E+3	1E–6	5E–9	2E–4	2E–3
		Y, see ^{234}Pu	—	3E+3	1E–6	4E–9	—	—
94	Plutonium-238	W, see ^{234}Pu	9E–1	7E–3	3E–12	—	—	—
			Bone surf (2E+0)	Bone surf (1E–2)	—	2E–14	2E–8	2E–7
		Y, see ^{234}Pu	—	2E–2	8E–12	2E–14	—	—
94	Plutonium-240	W, see ^{234}Pu	8E–1	6E–3	3E–12	—	—	—
			Bone surf (1E+0)	Bone surf (1E–2)	—	2E–14	2E–8	2E–7
		Y, see ^{234}Pu	—	2E–2	7E–12	—	—	—
			—	Bone surf (2E–2)	—	2E–14	—	—
94	Plutonium-241	W, see ^{234}Pu	4E+1	3E–1	1E–10	—	—	—
			Bone surf (7E+1)	Bone surf (6E–1)	—	8E–13	1E–6	1E–5
		Y, see ^{234}Pu	—	8E–1	3E–10	—	—	—
			—	Bone surf (1E+0)	—	1E–12	—	—
94	Plutonium-242	W, see ^{234}Pu	8E–1	7E–3	3E–12	—	—	—
			Bone surf (1E+0)	Bone surf (1E–2)	—	2E–14	2E–8	2E–7
		Y, see ^{234}Pu	—	2E–2	7E–12	—	—	—
			—	Bone surf (2E–2)	—	2E–14	—	—

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
94	Plutonium-243	W, see ^{234}Pu	2E+4	4E+4	2E–5	5E–8	2E–4	2E–3
		Y, see ^{234}Pu	—	4E+4	2E–5	5E–8	—	—
94	Plutonium-244	W, see ^{234}Pu	8E–1 Bone surf (2E+0)	7E–3 Bone surf (1E–2)	3E–12 —	— 2E–14	— 2E–8	— 2E–7
		Y, see ^{234}Pu	— —	2E–2 Bone surf (2E–2)	7E–12 —	— 2E–14	— —	— —
94	Plutonium-245	W, see ^{234}Pu	2E+3	5E+3	2E–6	6E–9	3E–5	3E–4
		Y, see ^{234}Pu	—	4E+3	2E–6	6E–9	—	—
94	Plutonium-246	W, see ^{234}Pu	4E+2 LLI wall (4E+2)	3E+2 —	1E–7 —	4E–10 —	— 6E–6	— 6E–5
		Y, see ^{234}Pu	—	3E+2	1E–7	4E–10	—	—
95	Americium-237[2]	W, all compounds	8E+4	3E+5	1E–4	4E–7	1E–3	1E–2
95	Americium -238[2]	W, all compounds	4E+4 —	3E+3 Bone surf (6E+3)	1E–6 —	— 9E–9	5E–4 —	5E–3 —
95	Americium -239	W, all compounds	5E+3	1E+4	5E–6	2E–8	7E–5	7E–4
95	Americium -240	W, all compounds	2E+3	3E+3	1E–6	4E–9	3E–5	3E–4
95	Americium -241	W, all compounds	8E–1 Bone surf (1E+0)	6E–3 Bone surf (1E–2)	3E–12 —	— 2E–14	— 2E–8	— 2E–7
95	Americium -242	W, all compounds	4E+3 —	8E+1 Bone surf (9E+1)	4E–8 —	— 1E–10	5E–5 —	5E–4 —
95	Americium -243	W, all compounds	8E–1 Bone surf (1E+0)	6E–3 Bone surf (1E–2)	3E–12 —	— 2E–14	— 2E–8	— 2E–7
95	Americium -244m[2]	W, all compounds	6E+4 St. wall (8E+4)	4E+3 Bone surf (7E+3)	2E–6 —	— 1E–8	— 1E–3	— 1E–2
95	Americium -244	W, all compounds	3E+3 —	2E+2 Bone surf (3E+2)	8E–8 —	— 4E–10	4E–5 —	4E–4 —
95	Americium -245	W, all compounds	3E+4	8E+4	3E–5	1E–7	4E–4	4E–3
95	Americium -246m[2]	W, all compounds	5E+4 St. wall (6E+4)	2E+5 —	8E–5 —	3E–7 —	— 8E–4	— 8E–3
95	Americium -246[2]	W, all compounds	3E+4	1E+5	4E–5	1E–7	4E–4	4E–3
96	Curium-238	W, all compounds	2E+4	1E+3	5E–7	2E–9	2E–4	2E–3
96	Curium-240	W, all compounds	6E+1 Bone surf (8E+1)	6E–1 Bone surf (6E–1)	2E–10 —	— 9E–13	— 1E–6	— 1E–5
96	Curium-241	W, all compounds	1E+3 —	3E+1 Bone surf (4E+1)	1E–8 —	— 5E–11	2E–5 —	2E–4 —
96	Curium-242	W, all compounds	3E+1 Bone surf (5E+1)	3E–1 Bone surf (3E–1)	1E–10 —	— 4E–13	— 7E–7	— 7E–6
96	Curium-243	W, all compounds	1E+0 Bone surf (2E+0)	9E–3 Bone surf (2E–2)	4E–12 —	— 2E–14	— 3E–8	— 3E–7
96	Curium-244	W, all compounds	1E+0 Bone surf (3E+0)	1E–2 Bone surf (2E–2)	5E–12 —	— 3E–14	— 3E–8	— 3E–7
96	Curium-245	W, all compounds	7E–1 Bone surf (1E+0)	6E–3 Bone surf (1E–2)	3E–12 —	— 2E–14	— 2E–8	— 2E–7
96	Curium-246	W, all compounds	7E–1 Bone surf (1E+0)	6E–3 Bone surf (1E–2)	3E–12 —	— 2E–14	— 2E–8	— 2E–7
96	Curium-247	W, all compounds	8E–1 Bone surf (1E+0)	6E–3 Bone surf (1E–2)	3E–12 —	— 2E–14	— 2E–8	— 2E–7
96	Curium-248	W, all compounds	2E–1 Bone surf (4E–1)	2E–3 Bone surf (3E–3)	7E–13 —	— 4E–15	— 5E–9	— 5E–8

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
96	Curium-249[2]	W, all compounds	5E+4	2E+4	7E–6	—	7E–4	7E–3
			—	Bone surf (3E+4)	—	4E–8	—	—
96	Curium-250	W, all compounds	4E–2	3E–4	1E–13	—	—	—
			Bone surf (6E–2)	Bone surf (5E–4)	—	8E–16	9E–10	9E–9
97	Berkelium-245	W, all compounds	2E+3	1E+3	5E–7	2E–9	3E–5	3E–4
97	Berkelium-246	W, all compounds	3E+3	3E+3	1E–6	4E–9	4E–5	4E–4
97	Berkelium-247	W, all compounds	5E–1	4E–3	2E–12	—	—	—
			Bone surf (1E+0)	Bone surf (4E+0)	—	1E–14	2E–8	2E–7
97	Berkelium-249	W, all compounds	2E+2	2E+0	7E–10	—	—	—
			Bone surf (5E+2)	Bone surf (4E+0)	—	5E–12	6E–6	6E–5
97	Berkelium-250	W, all compounds	9E+3	3E+2	1E–7	—	1E–4	1E–3
			—	Bone surf (7E+2)	—	1E–9	—	—
98	Californium-244[2]	W, all compounds except those given for Y	3E+4	6E+2	2E–7	8E–10	—	—
			St. wall (3E+4)	—	—	—	4E–4	4E–3
		Y, oxides and hydroxides	—	6E+2	2E–7	8E–10	—	—
98	Californium-246	W, see ^{244}Cf	4E+2	9E+0	4E–9	1E–11	5E–6	5E–5
		Y, see ^{244}Cf	—	9E+0	4E–9	1E–11	—	—
98	Californium-248	W, see ^{244}Cf	8E+0	6E–2	3E–11	—	—	—
			Bone surf (2E+1)	Bone surf (1E–1)	—	2E–13	2E–7	2E–6
		Y, see ^{244}Cf	—	1E–1	4E–11	1E–13	—	—
98	Californium-249	W, see ^{244}Cf	5E–1	4E–3	2E–12	—	—	—
			Bone surf (1E+0)	Bone surf (9E–3)	—	1E–14	2E–8	2E–7
		Y, see ^{244}Cf	—	1E–2	4E–12	—	—	—
			—	Bone surf (1E–2)	—	2E–14	—	—
98	Californium-250	W, see ^{244}Cf	1E+0	9E–3	4E–12	—	—	—
			Bone surf (2E+0)	Bone surf (2E–2)	—	3E–14	3E–8	3E–7
		Y, see ^{244}Cf	—	3E–2	1E–11	4E–14	—	—
98	Californium-251	W, see ^{244}Cf	5E–1	4E–3	2E–12	—	—	—
			Bone surf (1E+0)	Bone surf (9E–3)	—	1E–14	2E–8	2E–7
		Y, see ^{244}Cf	—	1E–2	4E–12	—	—	—
			—	Bone surf (1E–2)	—	2E–14	—	—
98	Californium-252	W, see ^{244}Cf	2E+0	2E–2	8E–12	—	—	—
			Bone surf (5E+0)	Bone surf (4E–2)	—	5E–14	7E–8	7E–7
		Y, see ^{244}Cf	—	3E–2	1E–11	5E–14	—	—
98	Californium-253	W, see ^{244}Cf	2E+2	2E+0	8E–10	3E–12	—	—
			Bone surf (4E+2)	—	—	—	5E–6	5E–5
		Y, see ^{244}Cf	—	2E+0	7E–10	2E–12	—	—
98	Californium-254	W, see ^{244}Cf	2E+0	2E–2	9E–12	3E–14	3E–8	3E–7
		Y, see ^{244}Cf	—	2E–2	7E–12	2E–14	—	—
99	Einsteinium-250	W, all compounds	4E+4	5E+2	2E–7	—	6E–4	6E–3
			—	Bone surf (1E+3)	—	2E–9	—	—
99	Einsteinium-251	W, all compounds	7E+3	9E+2	4E–7	—	1E–4	1E–3
			—	Bone surf (1E+3)	—	2E–9	—	—
99	Einsteinium-254m	W, all compounds	3E+2	1E+1	4E–9	1E–11	—	—
			LLI wall (3E+2)	—	—	—	4E–6	4E–5
99	Einsteinium-254	W, all compounds	8E+0	7E–2	3E–11	—	—	—
			Bone surf (2E+1)	Bone surf (1E–1)	—	2E–13	2E–7	2E–6
100	Fermium-252	W, all compounds	5E+2	1E+1	5E–9	2E–11	6E–6	6E–5
100	Fermium-253	W, all compounds	1E+3	1E+1	4E–9	1E–11	1E–5	1E–4

Atomic No.	Radionuclide	Class	Table 1 Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table 1 Occupational Values Col. 2 Inhalation ALI (μCi)	Table 1 Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table 2 Effluent Concentrations Col. 1 Air (μCi/ml)	Table 2 Effluent Concentrations Col. 2 Water (μCi/ml)	Table 3 Release to Sewers Monthly Average Concentration (μCi/ml)
100	Fermium-254	W, all compounds	3E+3	9E+1	4E–8	1E–10	4E–5	4E–4
100	Fermium-255	W, all compounds	5E+2	2E+1	9E–9	3E–11	7E–6	7E–5
100	Fermium-257	W, all compounds	2E+1	2E–1	7E–11	—	—	—
			Bone surf (4E+1)	Bone surf (2E–1)	—	3E–13	5E–7	5E–6
101	Mendelevium-257	W, all compounds	7E+3	8E+1	4E–8	—	1E–4	1E–3
			—	Bone surf (9E+1)	—	1E–10	—	—
101	Mendelevium-258	W, all compounds	3E+1	2E–1	1E–10	—	—	—
			Bone surf (5E+1)	Bone surf (3E–1)	—	5E–13	6E–7	6E–6
Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-live less than 2 hours		Submersion[1]	—	2E+2	1E–7	1E–9	—	—
Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life greater that 2 hours		…	—	2E–1	1E–10	1E–12	1E–8	1E–7
Any single radionuclide not listed above that decays by alpha emission or spontaneous fission, or any mixture for which either the identity or the concentration of any radionuclide in the mixture is not known		…	—	4E–4	2E–13	1E–15	2E–9	2E–8

[1]"Submersion" means that values given are for submersion in a hemispherical semi-infinite cloud of airborne material.

[2]These radionuclides have radiological half-lives less than 2 hours. The total dose equivalent received during operations with these radionuclides might include a significant contribution from external exposure. The DAC values for all radionuclides other than those designated Class "Submersion," are based upon the committed effective dose equivalent due to the intake of the radionuclide into the body and do NOT include potentially significant contributions to dose equivalent from external exposures. The licensee may substitute 1E–7 μCi/ml for the listed DAC to account for the submersion dose prospectively, but should use individual monitoring devices or other radiation measuring instruments that measure external exposure to demonstrate compliance with the limits. (See § 20.1203.)

[3] For soluble mixtures of U-238, U-234, and U-235 in air, chemical toxicity may be the limiting factor (see § 20.1201(e)). If the percent by weight (enrichment) of U-235 is not greater than 5, the concentration value for a 40-hour workweek is 0.2 milligram uranium per cubic meter of air average. For any enrichment, the product of the average concentration and time of exposure during a 40-hour workweek shall not exceed 8E–3 (SA) μCi-hr/ml, where SA is the specific activity of the uranium inhaled. The specific activity for natural uranium is 6.77E–7 curies per gram U. The specific activity for other mixtures of U-238, U-235, and U-234, if not known, shall be:

SA = 3.6E–7 curies/gram U, U depleted

$SA = [0.4 + 0.38\ (\text{enrichment}) + 0.0034\ (\text{enrichment})^2]\ E{-}6, \text{enrichment} \geq 0.72$

where enrichment is the percentage by weight of U-235, expressed as percent.

Note:

1. If the identity of each radionuclide in a mixture is known but the concentration of one or more of the radionuclides in the mixture is not known, the DAC for mixture shall be the most restrictive DAC of any radionuclide in the mixture.

2. If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in this appendix are not present in the mixture, the inhalation ALI, DAC, and effluent and sewage concentrations for the mixture are the lowest values specified in this appendix for any radionuclide that is not known to be absent from the mixture; or

	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Release to Sewers
	Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
				Inhalation		
Radionuclide	Oral Ingestion ALI (µCi)	ALI (µCi)	DAC (µCi/ml)	Air (µCi/ml)	Water (µCi/ml)	Monthly Average Concentration (µCi/ml)
If it is known that Ac-227-D and Cm-250-W are not present	—	7E–4	3E–13	—	—	—
If, in addition, it is know that Ac-227-W, Y, Th-229-W, Th-230-W, Th-232-W, Y, Pa-231-W, Y, Np-237-W, Pu-239-W, Pu-240-W, Pu-242-W, Am-241-W, Am-242m-W, Am-243-W, Cm-245-W, Cm-246-W, Cm-247-W, Cm-248-W, Bk-247-W, Cf-249-W, and Cf-251-W are not present	—	7E–3	3E–12	—	—	—
If, in addition it is known that Sm-146-W, Sm-147-W, Gd-148-D, W, Th-228-W, Y, Th-230-Y, U-232-Y, Y-233-Y, U-234-Y, U-235-Y, U-236-Y, U-238-Y, Np-236-W, Pu-236-W, Y, Pu-238-W, Y, Pu-239-Y, Pu-240-Y, Pu-242-Y, Pu-244-W, Y, Cm-243-W, Cm-244-W, Cf-248-W, Cf-249-Y, Cf-250-W, Cf-251-Y, Cf-252-W, Y, and Cf-254-W, Y are not present	—	7E–2	3E–11	—	—	—
If, in addition, it is known that Pb-210-D, Bi-210m-W, Po-210-D, W, Ra-223-W, Ra-225-W, Ra-226-W, Ac-225-D, W, Y, Th-227-W, Y, U-230-D, W, Y, U-232-D, W, Pu-241-W, Cm-240-W, Cm-242-W, Cf-248-Y, Es-254-W, Fm-257-W, and Md-258-W are not present	—	7E–1	3E–10	—	—	—
If, in addition, it is known that Si-32-Y, Ti-44-Y, Fe-60-D, Sr-90-Y, Zr-93-D, Cd-113m-D, Cd-113-D, In-115-D, W, La-138-D, Lu-176-W, Hf-178m-D, W, Hf-182-D, W, Bi-210m-D, Ra-224-W, Ra-228-W, Ac-226-D, W, Y, Pa-230-W, Y, U-233-D, W, U-234-D, W, U-235-D, W, U-236-D, W, U-238-D, W, Pu-241-Y, Bk-249-W, Cf-253-W, Y, and Es-253-W are not present.	—	7E+0	3E–9	—	—	—
If it is known that Ac-227-D, W, Y, Th-229-W, Y, Th-232-W, Y, Pa-231-W, Y, Cm-248-W, and Cm-250-W are not present	—	—	—	1E–14	—	—

	Table 1 Occupational Values			Table 2 Effluent Concentrations		Table 3 Release to Sewers
	Col. 1	Col. 2	Col. 3	Col. 1	Col. 2	
				Inhalation		
Radionuclide	Oral Ingestion ALI (μCi)	ALI (μCi)	DAC (μCi/ml)	Air (μCi/ml)	Water (μCi/ml)	Monthly Average Concentration (μCi/ml)
If, in addition, it is known that Sm-146-W, Gd-148-D, W, Dg-152-D, Th-228-W, Y, Th-230-W, Y, U-232-Y, U-233-Y, U-234-Y, U-235-Y, U-236-Y, U-238-Y, U-Nat-Y, Np-236-W, Np-237-W, Pu-236-W, y, Pu-238-W, Y, Pu-239-W, Y, Pu-240-W, Y Pu-242-W, Y, Pu-244-W, Y, Am-241-W, Am-242m-W, Am-243-W, Cm-243-W, Cm-244-W, Cm-245-W, Cm-246-W, Cm-247-W, Bk-247-W, Cf-249-W, Y, Cf-250-W, Y, Cf-251-W, Y, Cf-252-W, Y, and Cf-254-W, Y are not present	—	—	—	1E–13	—	—
If, in addition, it is known that Sm-147-W, Gd-152-W, Pb-210-D, Bi-210m-W, Po-210-D, Bi-210m-W, Po-210-D, W, Ra-223-W, Ra-225-W, Ra-226-W, Ac-225-D, W, Y, Th-227-W, Y, U-230-D, W, Y, U-232-D, W, U-Nat-W, Pu-241-W, Cm-240-W, Cm-242-W, Cf-248-W, Y, Es-254-W, Fm-257-W, and Md-258-W are not present	—	—	—	1E–12	—	—
If, in addition, it is known that Fe-60, Sr-90, Cd-113m, Cd-113, In-115, I-129, Cs-134, Sm-145, Sm-147, Gd-148, Gd-152, Hg-194 (organic), Bi-210m, Ra-223, Ra-224, Ra-225, Ac-225, Th-228, Th-230, U-233, U-234, U-235, U-236, U-238, U-Nat, Cm-242, Cf-248, Es-254, Fm-257, and Md-258 are not present	—	—	—	—	1E–6	1E–5

3. If a mixture of radionuclides consists of uranium and its daughters in ore dust (10 μm AMAD particle distribution assumed) prior to chemical separation of the uranium from the ore, the following values may be used for the DAC of the mixture: 6E–11 μCi of gross alpha activity from uranium-238, uranium-234, thorium-230, and radium-226 per milliliter of air; 3E–11 μCi of natural uranium per milliliter of air; or 45 micrograms of natural uranium per cubic meter of air.

4. If the identity and concentration of each radionuclide in a mixture are known, the limiting values should be derived as follows: determine, for each radionuclide in the mixture, the ration between the concentration present in the mixture and the concentration otherwise established in Appendix B for the specific radionuclide when not in a mixture. The sum of such ratios for all of the radionuclides in the mixture may not exceed "1" (*i.e.*, unity).

   Example: If radionuclides "A," "B," and "C" are present in concentrations C_A, C_B, and C_C, and if the applicable DACs are DAC_A, DAC_B, and DAC_C, respectively, then the concentrations shall be limited so that the following relationship exists:

$$\frac{C_A}{DAC_A} + \frac{C_B}{DAC_B} + \frac{C_C}{DAC_C} \leq 1$$

Appendix C to §§ 20.1001-20.2401 Quantities of Licensed Material Requiring Labeling

Radionuclide	Quantity (μCi)
Hydrogen-3	1,000
Beryllium-7	1,000
Beryllium-10	1
Carbon-11	1,000
Carbon-14	100
Fluorine-18	1,000
Sodium-22	10
Sodium-24	100
Magnesium-28	100
Aluminum-26	10
Silicon-31	1,000
Silicon-32	1
Phosphorus-32	10
Phosphorus-33	100
Sulfur-35	100
Chlorine-36	10
Chlorine-38	1,000
Argon-39	1,000
Argon-41	1,000
Potassium-40	100
Potassium-42	1,000
Potassium-43	1,000
Potassium-44	1,000
Potassium-45	1,000
Calcium-41	100
Calcium-45	100
Calcium-47	100
Scandium-43	1,000
Scandium-44m	100
Scandium-44	100
Scandium-46	10
Scandium-47	100
Scandium-48	100
Scandium-49	1,000
Titanium-44	1
Titanium-45	1,000
Vanadium-47	1,000
Vanadium-48	100
Vanadium-49	1,000
Chromium-48	1,000
Chromium-49	1,000
Chromium-51	1,000
Manganese-51	1,000
Manganese-52m	1,000
Manganese-52	100
Manganese-53	1,000
Manganese-54	100
Manganese-56	1,000
Iron-52	100
Iron-55	100
Iron-59	10
Iron-60	1
Cobalt-55	100
Cobalt-56	10
Cobalt-57	100
Cobalt-58m	1,000
Cobalt-58	100
Cobalt-60m	1,000
Cobalt-60	1
Cobalt-61	1,000
Cobalt-62m	1,000
Nickel-56	100
Nickel-57	100
Nickel-59	100
Nickel-63	100
Nickel-65	1,000
Nickel-66	10
Copper-60	1,000
Copper-61	1,000
Copper-64	1,000
Copper-67	1,000
Zinc-62	100
Zinc-63	1,000
Zinc-65	10
Zinc-69m	100
Zinc-69	1,000
Zinc-71m	1,000
Zinc-72	100
Gallium-65	1,000
Gallium-66	100
Gallium-67	1,000
Gallium-68	1,000
Gallium-70	1,000
Gallium-72	100
Gallium-73	1,000
Germanium-66	1,000
Germanium-67	1,000
Germanium-68	10
Germanium-69	1,000
Germanium-71	1,000
Germanium-75	1,000
Germanium-77	1,000
Germanium-78	1,000
Arsenic-69	1,000
Arsenic-70	1,000
Arsenic-71	100
Arsenic-72	100
Arsenic-73	100
Arsenic-74	100
Arsenic-76	100
Arsenic-77	100
Arsenic-78	1,000
Selenium-70	1,000
Selenium-73m	1,000
Selenium-73	100
Selenium-75	100
Selenium-79	100
Selenium-81m	1,000
Selenium-81	1,000
Selenium-83	1,000
Bromine-74m	1,000
Bromine-74	1,000
Bromine-75	1,000
Bromine-76	100
Bromine-77	1,000
Bromine-80m	1,000
Bromine-80	1,000
Bromine-82	100
Bromine-83	1,000
Bromine-84	1,000
Krypton-74	1,000
Krypton-76	1,000
Krypton-77	1,000
Krypton-79	1,000
Krypton-81	1,000
Krypton-83m	1,000
Krypton-85m	1,000
Krypton-85	1,000
Krypton-87	1,000
Krypton-88	1,000
Rubidium-79	1,000
Rubidium-81m	1,000
Rubidium-81	1,000
Rubidium-82m	1,000
Rubidium-83	100
Rubidium-84	100
Rubidium-86	100
Rubidium-87	100
Rubidium-88	1,000
Rubidium-89	1,000
Strontium-80	100
Strontium-81	1,000
Strontium-83	100
Strontium-85m	1,000
Strontium-85	100
Strontium-87m	1,000
Strontium-89	10
Strontium-90	0.1
Strontium-91	100
Strontium-92	100
Yttrium-86m	1,000
Yttrium-86	100
Yttrium-87	100
Yttrium-88	10
Yttrium-90m	1,000
Yttrium-90	10
Yttrium-91m	1,000
Yttrium-91	10
Yttrium-92	100
Yttrium-93	100
Yttrium-94	1,000
Yttrium-95	1,000
Zirconium-86	100
Zirconium-88	10
Zirconium-89	100

Radionuclide	Quantity (μCi)
Zirconium-93	1
Zirconium-95	10
Zirconium-97	100
Niobium-88	1,000
Niobium-89m (66 min)	1,000
Niobium-89 (122 min)	1,000
Niobium-90	100
Niobium-93m	10
Niobium-94	1
Niobium-95m	100
Niobium-95	100
Niobium-96	100
Niobium-97	1,000
Niobium-98	1,000
Molybdenum-90	100
Molybdenum-93m	100
Molybdenum-93	10
Molybdenum-99	100
Molybdenum-101	1,000
Technetium-93m	1,000
Technetium-93	1,000
Technetium-94m	1,000
Technetium-94	1,000
Technetium-96m	1,000
Technetium-96	100
Technetium-97m	100
Technetium-97	1,000
Technetium-98	10
Technetium-99m	1,000
Technetium-99	100
Technetium-101	1,000
Technetium-104	1,000
Ruthenium-94	1,000
Ruthenium-97	1,000
Ruthenium-103	100
Ruthenium-105	1,000
Ruthenium-106	1
Rhodium-99m	1,000
Rhodium-99	100
Rhodium-100	100
Rhodium-101m	1,000
Rhodium-101	10
Rhodium-102m	10
Rhodium-102	10
Rhodium-103m	1,000
Rhodium-105	100
Rhodium-106m	1,000
Rhodium-107	1,000
Palladium-100	100
Palladium-101	1,000
Palladium-103	100
Palladium-107	10
Palladium-109	100
Silver-102	1,000
Silver-103	1,000
Silver-104m	1,000
Silver-104	1,000
Silver-105	100
Silver-106m	100
Silver 106	1,000
Silver-108m	1
Silver-110m	10
Silver-111	100
Silver-112	100
Silver-115	1,000
Cadmium-104	1,000
Cadmium-107	1,000
Cadmium-109	1
Cadmium-113m	0.1
Cadmium-113	100
Cadmium-115m	10
Cadmium-115	100
Cadmium-117m	1,000
Cadmium-117	1,000
Indium-109	1,000
Indium-110 (69.1 min)	1,000
Indium-110 (4.9 h)	1,000
Indium-111	100
Indium-112	1,000
Indium-113m	1,000
Indium-114m	10
Indium-115m	1,000
Indium-115	100
Indium-116m	1,000
Indium-117m	1,000
Indium-117	1,000
Indium-119m	1,000
Tin-110	100
Tin-111	1,000
Tin-113	100
Tin-117m	100
Tin-119m	100
Tin-121m	100
Tin-121	1,000
Tin-123m	1,000
Tin-123	10
Tin-125	10
Tin-126	10
Tin-127	1,000
Tin-128	1,000
Antimony-115	1,000
Antimony-116m	1,000
Antimony-116	1,000
Antimony-117	1,000
Antimony-118m	1,000
Antimony-119	1,000
Antimony-120 (16 min)	1,000
Antimony-120 (5.76 d)	100
Antimony-122	100
Antimony-124m	1,000
Antimony-124	10
Antimony-125	100
Antimony-126m	1,000
Antimony-126	100
Antimony-127	100
Antimony-128 (10.4 min)	1,000
Antimony-128 (9.01 h)	100
Antimony-129	100
Antimony-130	1,000
Antimony-131	1,000
Tellurium-116	1,000
Tellurium-121m	10
Tellurium-123m	10
Tellurium-123	100
Tellurium-125m	10
Tellurium-127m	10
Tellurium-127	1,000
Tellurium-129m	10
Tellurium-129	1,000
Tellurium-131m	10
Tellurium-131	100
Tellurium-132	10
Tellurium-133m	100
Tellurium-133	1,000
Tellurium-134	1,000
Iodine-120m	1,000
Iodine-120	100
Iodine-121	1,000
Iodine-123	100
Iodine-124	10
Iodine-125	1
Iodine-126	1
Iodine-128	1,000
Iodine-129	1
Iodine-130	10
Iodine-131	1
Iodine-132m	100
Iodine-132	100
Iodine-133	10
Iodine-134	1,000
Iodine-135	100
Xenon-120	1,000
Xenon-121	1,000
Xenon-122	1,000
Xenon-123	1,000
Xenon-125	1,000
Xenon-127	1,000
Xenon-129m	1,000
Xenon-131m	1,000
Xenon-133m	1,000
Xenon-133	1,000
Xenon-135m	1,000
Xenon-135	1,000
Xenon-138	1,000
Cesium-125	1,000
Cesium-127	1,000
Cesium-129	1,000
Cesium-130	1,000
Cesium-131	1,000
Cesium-132	100
Cesium-134m	1,000
Cesium-134	10
Cesium-135m	1,000
Cesium-135	100

Radionuclide	Quantity (μCi)
Cesium-136	10
Cesium-137	10
Cesium-138	1,000
Barium-126	1,000
Barium-128	100
Barium-131m	1,000
Barium-131	100
Barium-133m	100
Barium-133	100
Barium-135m	100
Barium-139	1,000
Barium-140	100
Barium-141	1,000
Barium-142	1,000
Lanthanum-131	1,000
Lanthanum-132	100
Lanthanum-135	1,000
Lanthanum-137	10
Lanthanum-138	100
Lanthanum-140	100
Lanthanum-141	100
Lanthanum-142	1,000
Lanthanum-143	1,000
Cerium-134	100
Cerium-135	100
Cerium-137m	100
Cerium-137	1,000
Cerium-139	100
Cerium-141	100
Cerium-143	100
Cerium-144	1
Praseodymium-136	1.000
Praseodymium-137	1,000
Praseodymium-138m	1,000
Praseodymium-139	1,000
Praseodymium-142m	1,000
Praseodymium-142	100
Praseodymium-143	100
Praseodymium-144	1,000
Praseodymium-145	100
Praseodymium-147	1,000
Neodymium-136	1,000
Neodymium-138	100
Neodymium-139m	1,000
Neodymium-139	1,000
Neodymium-141	1,000
Neodymium-147	100
Neodymium-149	1,000
Neodymium-151	1,000
Promethium-141	1,000
Promethium-143	100
Promethium-144	10
Promethium-145	10
Promethium-146	1
Promethium-147	10
Promethium-148m	10
Promethium-148	10
Promethium-149	100
Promethium-150	1,000

Radionuclide	Quantity (μCi)
Promethium-151	100
Samarium-141m	1,000
Samarium-141	1,000
Samarium-142	1,000
Samarium-145	100
Samarium-146	1
Samarium-147	100
Samarium-151	10
Samarium-153	100
Samarium-155	1,000
Samarium-156	1,000
Europium-145	100
Europium-146	100
Europium-147	100
Europium-148	10
Europium-149	100
Europium-150	100
(12.62 h)	
Europium-150 (34.2 y)	1
Europium-152m	100
Europium-152	1
Europium-154	1
Europium-155	10
Europium-156	100
Europium-157	100
Europium-158	1,000
Gadolinium-145	1,000
Gadolinium-146	10
Gadolinium-147	100
Gadolinium-148	0.001
Gadolinium-149	100
Gadolinium-151	10
Gadolinium-152	100
Gadolinium-153	10
Gadolinium-159	100
Terbium-147	1,000
Terbium-149	100
Terbium-150	1,000
Terbium-151	100
Terbium-153	1,000
Terbium-154	100
Terbium-155	1,000
Terbium-156m (5.0 h)	1,000
Terbium-156m	1,000
(24.4 h)	
Terbium-156	100
Terbium-157	10
Terbium-158	1
Terbium-160	10
Terbium-161	100
Dysprosium-155	1,000
Dysprosium-157	1,000
Dysprosium-159	100
Dysprosium-165	1,000
Dysprosium-166	100
Holmium-155	1,000
Holmium-157	1,000
Holmium-159	1,000
Holmium-161	1,000

Radionuclide	Quantity (μCi)
Holmium-162m	1,000
Holmium-162	1,000
Holmium-164m	1,000
Holmium-164	1,000
Holmium-166m	1
Holmium-166	100
Holmium-167	1,000
Erbium-161	1,000
Erbium-165	1,000
Erbium-169	100
Erbium-171	100
Erbium-172	100
Thulium-162	1,000
Thulium-166	100
Thulium-167	100
Thulium-170	10
Thulium-171	10
Thulium-172	100
Thulium-173	100
Thulium-175	1,000
Ytterbium-162	1,000
Ytterbium-166	100
Ytterbium-167	1,000
Ytterbium-169	100
Ytterbium-175	100
Ytterbium-177	1,000
Ytterbium-178	1,000
Lutetium-169	100
Lutetium-170	100
Lutetium-171	100
Lutetium-172	100
Lutetium-173	10
Lutetium-174m	10
Lutetium-174	10
Lutetium-176m	1,000
Lutetium-176	100
Lutetium-177m	10
Lutetium-177	100
Lutetium-178m	1,000
Lutetium-178	1,000
Lutetium-179	1,000
Hafnium-170	100
Hafnium-172	1
Hafnium-173	1,000
Hafnium-175	100
Hafnium-177m	1,000
Hafnium-178m	0.1
Hafnium-179m	10
Hafnium-180m	1,000
Hafnium-181	10
Hafnium-182m	1,000
Hafnium-182	0.1
Hafnium-183	1,000
Hafnium-184	100
Tantalum-172	1,000
Tantalum-173	1,000
Tantalum-174	1,000
Tantalum-175	1,000
Tantalum-176	100

Radionuclide	Quantity (μCi)
Tantalum-177	1,000
Tantalum-178	1,000
Tantalum-179	100
Tantalum-180m	1,000
Tantalum-180	100
Tantalum-182m	1,000
Tantalum-182	10
Tantalum-183	100
Tantalum-184	100
Tantalum-185	1,000
Tantalum-188	1,000
Tungsten-176	1,000
Tungsten-177	1,000
Tungsten-178	1,000
Tungsten-179	1,000
Tungsten-181	1,000
Tungsten-185	100
Tungsten-187	100
Tungsten-188	10
Rhenium-177	1,000
Rhenium-178	1,000
Rhenium-181	1,000
Rhenium-182 (12.7 h)	1,000
Rhenium-182 (64.0 h)	100
Rhenium-184m	10
Rhenium-184	100
Rhenium-186m	10
Rhenium-186	100
Rhenium-187	1,000
Rhenium-188m	1,000
Rhenium-188	100
Rhenium-189	100
Osmium-180	1,000
Osmium-181	1,000
Osmium-182	100
Osmium-185	100
Osmium-189m	1,000
Osmium-191m	1,000
Osmium-191	100
Osmium-193	100
Osmium-194	1
Iridium-182	1,000
Iridium-184	1,000
Iridium-185	1,000
Iridium-186	100
Iridium-187	1,000
Iridium-188	100
Iridium-189	100
Iridium-190m	1,000
Iridium-190	100
Iridium-192 (73.8 d)	1
Iridium-192m	10
(1.4 min)	
Iridium-194m	10
Iridium-194	100
Iridium-195m	1,000
Iridium-195	1,000
Platinum-186	1,000
Platinum-188	100

Radionuclide	Quantity (μCi)
Platinum-189	1,000
Platinum-191	100
Platinum-193m	100
Platinum-193	1,000
Platinum-195m	100
Platinum-197m	1,000
Platinum-197	100
Platinum-199	1,000
Platinum-200	100
Gold-193	1,000
Gold-194	100
Gold-195	10
Gold-198m	100
Gold-198	100
Gold-199	100
Gold-200m	100
Gold-200	1,000
Gold-201	1,000
Mercury-193m	100
Mercury-193	1,000
Mercury-194	1
Mercury-195m	100
Mercury-195	1,000
Mercury-197m	100
Mercury-197	1,000
Mercury-199m	1,000
Mercury-203	100
Thallium-194m	1,000
Thallium-194	1,000
Thallium-195	1,000
Thallium-197	1,000
Thallium-198m	1,000
Thallium-198	1,000
Thallium-199	1,000
Thallium-200	1,000
Thallium-201	1,000
Thallium-202	100
Thallium-204	100
Lead-195m	1,000
Lead-198	1,000
Lead-199	1,000
Lead-200	100
Lead-201	1,000
Lead-202m	1,000
Lead-202	10
Lead-203	1,000
Lead-205	100
Lead-209	1,000
Lead-210	0.01
Lead-211	100
Lead-212	1
Lead-214	100
Bismuth-200	1,000
Bismuth-201	1,000
Bismuth-202	1,000
Bismuth-203	100
Bismuth-205	100
Bismuth-206	100
Bismuth-207	10

Radionuclide	Quantity (μCi)
Bismuth-210m	0.1
Bismuth-210	1
Bismuth-212	10
Bismuth-213	10
Bismuth-214	100
Polonium-203	1,000
Polonium-205	1,000
Polonium-207	1,000
Polonium-210	0.1
Astatine-207	100
Astatine-211	10
Radon-220	1
Radon-222	1
Francium-222	100
Francium-223	100
Radium-223	0.1
Radium-224	0.1
Radium-225	0.1
Radium-226	0.1
Radium-227	1,000
Radium-228	0.1
Actinium-224	1
Actinium-225	0.01
Actinium-226	0.1
Actinium-227	0.001
Actinium-228	1
Thorium-226	10
Thorium-227	0.01
Thorium-228	0.001
Thorium-229	0.001
Thorium-230	0.001
Thorium-231	100
Thorium-232	100
Thorium-234	10
Thorium-natural	100
Protactinium-227	10
Protactinium-228	1
Protactinium-230	0.1
Protactinium-231	0.001
Protactinium-232	1
Protactinium-233	100
Protactinium-234	100
Uranium-230	0.01
Uranium-231	100
Uranium-232	0.001
Uranium-233	0.001
Uranium-234	0.001
Uranium-235	0.001
Uranium-236	0.001
Uranium-237	100
Uranium-238	100
Uranium-239	1,000
Uranium-240	100
Uranium-natural	100
Neptunium-232	100
Neptunium-233	1,000
Neptunium-234	100
Neptunium-235	100
Neptunium-236	0.001

Radionuclide	Quantity (μCi)
(1.15×10^5 y)	
Neptunium-236	1
(22.5 h)	
Neptunium-237	0.001
Neptunium-238	10
Neptunium-239	100
Neptunium-240	1,000
Plutonium-234	10
Plutonium-235	1,000
Plutonium-236	0.001
Plutonium-237	100
Plutonium-238	0.001
Plutonium-239	0.001
Plutonium-240	0.001
Plutonium-241	0.01
Plutonium-242	1,000
Plutonium-243	1,000
Plutonium-244	0.001
Plutonium-245	100
Americium-237	1,000
Americium-238	100
Americium-239	1,000
Americium-240	100
Americium-241	0.001
Americium-242m	0.001
Americium-242	10
Americium-243	0.001
Americium-244m	100
Americium-244	10
Americium-245	1,000
Americium-246m	1,000
Americium-246	1,000
Curium-238	100
Curium-240	0.1
Curium-241	1
Curium-242	0.01
Curium-243	0.001
Curium-244	0.001
Curium-245	0.001
Curium-246	0.001
Curium-247	0.001
Curium-248	0.001
Curium-249	1,000
Berkelium-245	100
Berkelium-246	100
Berkelium-247	0.001
Berkelium-249	0.1
Berkelium-250	10
Californium-244	100
Californium-246	1
Californium-248	0.01
Californium-249	0.001
Californium-250	0.001
Californium-251	0.001
Californium-252	0.001
Californium-253	0.1
Californium-254	0.001
Any alpha emitting radionuclide not listed	0.001

Radionuclide	Quantity (μCi)
Neptunium-236	1
(22.5 h)	
Neptunium-237	0.001
Neptunium-238	10
Neptunium-239	100
Neptunium-240	1,000
Plutonium-234	10
Plutonium-235	1,000
Plutonium-236	0.001
Plutonium-237	100
Plutonium-238	0.001
Plutonium-239	0.001
Plutonium-240	0.001
Plutonium-241	0.01
Plutonium-242	1,000
Plutonium-243	1,000
Plutonium-244	0.001
Plutonium-245	100
Americium-237	1,000
Americium-238	100
Americium-239	1,000
Americium-240	100
Americium-241	0.001
Americium-242m	0.001
Americium-242	10
Americium-243	0.001
Americium-244m	100
Americium-244	10
Americium-245	1,000
Americium-246m	1,000
Americium-246	1,000
Curium-238	100
Curium-240	0.1
Curium-241	1
Curium-242	0.01
Curium-243	0.001
Curium-244	0.001
Curium-245	0.001
Curium-246	0.001
Curium-247	0.001
Curium-248	0.001
Curium-249	1,000
Berkelium-245	100
Berkelium-246	100
Berkelium-247	0.001
Berkelium-249	0.1
Berkelium-250	10
Californium-244	100
Californium-246	1
Californium-248	0.01
Californium-249	0.001
Californium-250	0.001
Californium-251	0.001
Californium-252	0.001
Californium-253	0.1
Californium-254	0.001
	0.001

Radionuclide	Quantity (μCi)
Neptunium-236	1
(22.5 h)	
Neptunium-237	0.001
Neptunium-238	10
Neptunium-239	100
Neptunium-240	1,000
Plutonium-234	10
Plutonium-235	1,000
Plutonium-236	0.001
Plutonium-237	100
Plutonium-238	0.001
Plutonium-239	0.001
Plutonium-240	0.001
Plutonium-241	0.01
Plutonium-242	1,000
Plutonium-243	1,000
Plutonium-244	0.001
Plutonium-245	100
Americium-237	1,000
Americium-238	100
Americium-239	1,000
Americium-240	100
Americium-241	0.001
Americium-242m	0.001
Americium-242	10
Americium-243	0.001
Americium-244m	100
Americium-244	10
Americium-245	1,000
Americium-246m	1,000
Americium-246	1,000
Curium-238	100
Curium-240	0.1
Curium-241	1
Curium-242	0.01
Curium-243	0.001
Curium-244	0.001
Curium-245	0.001
Curium-246	0.001
Curium-247	0.001
Curium-248	0.001
Curium-249	1,000
Berkelium-245	100
Berkelium-246	100
Berkelium-247	0.001
Berkelium-249	0.1
Berkelium-250	10
Californium-244	100
Californium-246	1
Californium-248	0.01
Californium-249	0.001
Californium-250	0.001
Californium-251	0.001
Californium-252	0.001
Californium-253	0.1
Californium-254	0.001
	0.001

Radionuclide	Quantity (μCi)
above or mixtures of alpha emitters of unknown composition	
Einsteinium-250	100
Einsteinium-251	100
Einsteinium-253	0.1
Einsteinium-254m	1
Einsteinium-254	0.01
Fermium-252	1
Fermium-253	1
Fermium-254	10
Fermium-255	1
Fermium-257	0.01
Mendelevium-257	10
Mendelevium-258	0.01
Any radionuclide other than alpha emitting radionuclides not listed above, or mixtures of beta emitters of unknown composition	0.01

[1] The quantities listed above were derived by taking 1/10th of the most restrictive ALI listed in table 1, columns 1 and 2, of appendix B to §§ 20.1001-20.2401 of this part, rounding to the nearest factor of 10, and arbitrarily constraining the values listed between 0.001 and 1,000 μCi. Values of 100 μCi have been assigned for radionuclides having a radioactive half-life in excess of 10^9 years (except rhenium, 1000 μCi) to take into account their low specific activity.

Note: For purposes of §§ 20.1902(e), 20.1905(a), and 20.2201(a) where there is involved a combination of radionuclides in known amounts, the limit for the combination should be derived as follows: determine, for each radionuclide in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific radionuclide when not in combination. The sum of such ratios for all radionuclides in the combination may not exceed "1" (*i.e.*, unity).

Appendix D to §§ 20.1001-20.2401—United States Nuclear Regulatory Commission Regional Offices

	Address	Telephone (24 hour)
Region I: Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.	USNRC, Region I, 475 Allendale Road, King of Prussia, PA 19406	(610) 337-5000 (FTS) 346-5000
Region II: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, Puerto Rico, South Carolina, Tennessee, Virginia, Virgin Islands, and West Virginia.	USNRC, Region II, Atlanta Federal Center, 61 Forsyth Street, SW., Suite 23T85, Atlanta, GA 30303.	(404) 562-4400 (FTS) 841-4503
Region III: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin	USNRC, Region III, 799 Roosevelt Road, Glen Ellyn, IL 60137	(708) 790-5500 (FTS) 388-5500
Region IV: Alaska, Arizona, Arkansas, California, Colorado, Hawaii, Idaho, Kansas, Louisiana, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, Wyoming, and U.S. territories and possessions in the Pacific	USNRC, Region IV, 611 Ryan Plaza Drive, Suite 1000, Arlington, TX 76011	(817) 860-8100 (FTS) 728-8100

Appendix E to §§ 20.1001-20.2401—[Reserved]

Appendix F to §§ 20.1001-20.2401—Requirements for Low-Level-Waste Transfer for Disposal at Land Disposal Facilities and Manifests

I. Manifest

The shipment shall contain the name, address, and telephone number of the person generating the waste. The manifest shall also include the name, address, and telephone number or the name and EPA hazardous waste identification number of the person transporting the waste to the land disposal facility. The manifest must also indicate as completely as practical: a physical description of the waste, the volume, radionuclide identity and quantity, the total radioactivity, and the principal chemical form. The solidification agent must specified. Waste containing more than 0.1% chelating agents by weight must be identified and weight percentage of the chelating agent estimated. Wastes classified as Class A, Class B, or Class C in § 61.55 of this chapter must be clearly identified as such in the manifest. The total quantity of the radionuclides ^{3}H, ^{14}C, ^{99}Tc, and ^{129}I must be shown. The manifest required by this paragraph may be shipping papers used to meet Department of Transportation or Environmental Protection Agency regulations or requirements of the receiver, provided all the required information is included. Copies of manifests required by this section may be legible carbon copies or legible photocopies.

II. Certification.

The waste generator shall include in the shipment manifest a certification that the transported materials are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation and the Commission. An authorized representative of the waste generator shall sign and date the manifest.

III. Control and Tracking

A. Any generating licensee who transfers radioactive waste to a land disposal facility or a licensed waste collector shall comply with the requirements in paragraphs A.1 through 8 of this section. Any generating licensee who transfers waste to a licensed waste processor who treats or repackages waste shall comply with the requirements of paragraphs A.4 through 8 of this section. A licensee shall:

1. Prepare all wastes so that the waste is classified according to § 61.55 of this chapter and meets the waste characteristics requirements in § 61.56 of this chapter;

2. Label each package of waste to identify whether it is Class A waste, Class B waste, or Class C waste, in accordance with § 61.55 of this chapter;

3. Conduct a quality control program to ensure compliance with §§ 61.55 and 61.56 of this chapter; the program must include management evaluation of audits;

4. Prepare shipping manifests to meet the requirements of sections I and II of this appendix;

5. Forward a copy of the manifest to the intended recipient, at the time shipment, or deliver to a collector at the time the waste is collected, obtaining acknowledgment of receipt in the form of a signed copy of the manifest or equivalent documentation from the collector;

6. Include one copy of the manifest with the shipment;

7. Retain a copy of the manifest and documentation of acknowledgment of receipt as the record of transfer of licensed material as required by parts 30, 40, and 70 of this chapter. This includes those manifests and documents required under the standards for protection against radiation in effect prior to January 1, 1994; and

8. For any shipments or any part of a shipment for which acknowledgment of receipt has not been received within the times set forth in this section, conduct an investigation in accordance with paragraph E of this appendix.

B. Any waste collector licensee who handles only prepackaged waste shall:

1. Acknowledge receipt of the waste from the generator within 1 week of receipt by returning a signed copy of the manifest or equivalent documentation;

2. Prepare a new manifest to reflect consolidated shipments; the new manifest shall serve as a listing or index for the detailed generator manifests. Copies of the generator manifests shall be a part of the new manifest. The waste collector may prepare a new manifest without attaching the generator manifests, provided the new manifest contains for each package the information specified in section I of this appendix. The collector licensee shall certify that nothing has been done to the waste that would invalidate the generator's certification;

3. Forward a copy of the new manifest to the land disposal facility operator at the time of shipment;

4. Include the new manifest with the shipment to the disposal site;

5. Retain a copy of the manifest and documentation of acknowledgment of receipt as the record of transfer of licensed material as required by parts 30, 40, and 70 of this chapter, and retain information from the generator manifest until the license is terminated. This includes those manifests and documents of acknowledgment of receipt required under the standards for protection against radiation in effect prior to January 1, 1994; and

6. For any shipments or any part of a shipment for which acknowledgment of receipt is not received within the times set forth in this section, conduct an investigation in accordance with section III, E of this appendix.

C. Any licensed waste processor who treats or repackages wastes shall:

1. Acknowledge receipt of the waste from the generator within 1 week of receipt by returning a signed copy of the manifest or equivalent documentation;

2. Prepare a new manifest that meets the requirements of sections I and II of this appendix. Preparation of the new manifest reflects that the processor is responsible for the waste;

3. Prepare all wastes so that the waste is classified according to § 61.55 of this chapter and meets the waste characteristics requirements in § 61.56 of this chapter;

4. Label each package of waste to identify whether it is Class A waste, Class B waste, or Class C waste, in accordance with §§ 61.55 and 61.56 of this chapter;

5. Conduct a quality control program to ensure compliance with §§ 61.55 and 61.56 of this chapter. The program shall include management evaluation of audits;

6. Forward a copy of the new manifest to the disposal site operator or waste collector at the time of shipment, or deliver to a collector at the time the waste is collected, obtaining acknowledgment of receipt in the form of a signed copy of the manifest or equivalent documentation by the collector;

7. Include the new manifest with the shipment;

8. Retain copies of original manifests and new manifests and documentation of acknowledgment of receipt as the record of transfer of licensed material required by parts 30, 40, and 70 of this chapter. This includes those manifests and documents of acknowledgment of receipt required under the standards for protection against radiation in effect prior to January 1, 1994; and

9. For any shipment or part of a shipment for which acknowledgment is not received within the times set forth in this section, conduct an investigation in accordance with section III.E of this appendix.

D. The land disposal facility operator shall:

1. Acknowledge receipt of the waste within 1 week of receipt by returning a signed copy of the manifest or equivalent documentation to the shipper. The shipper to be notified is the licensee who last possessed the waste and transferred the waste to the operator. The returned copy of the manifest or equivalent documentation shall indicate any discrepancies between materials listed on the manifest and materials received;

2. Maintain copies of all completed manifests or equivalent documentation until the license is terminated. This includes those manifests or equivalent documents required under the standards for protection against radiation in effect prior to January 1, 1994; and

3. Notify the shipper (*i.e.*, the generator, the collector, or processor) and the Administrator of the nearest Commission Regional Office listed in appendix D to this part when any shipment or part of a shipment has not arrived within 60 days after the advance manifest was received.

E. Any shipment or part of a shipment for which acknowledgment is not received with the times set forth in this section must:

1. Be investigated by the shipper if the shipper has not received notification or receipt within 20 days after transfer; and

2. Be traced and reported. The investigation shall include tracing the shipment and filing a report with the nearest Commission Regional Office listed in appendix D to this part. Each licensee who conducts a trace investigation shall file a written report with the appropriate NRC Regional Office within 2 weeks of completion of the investigation.

Appendix G to 10 CFR Part 20—Requirements for Transfers of Low-Level Radioactive Waste Intended for Disposal at Licensed Land Disposal Facilities and Manifests

I. Manifest

A waste generator, collector, or processor who transports, or offers for transportation, low-level radioactive waste intended for ultimate disposal at a licensed low-level radioactive waste land disposal facility must prepare a Manifest (OMB Control Numbers 3150-0164, -0165-, and -0166) reflecting information requested on applicable NRC Forms 540 [Uniform Low-Level Radioactive Waste Manifest (Shipping Paper)] and 541 [Uniform Low-Level Radioactive Waste Manifest (container and Waste Description)] and, if necessary, on an applicable NRC Form 542 [Uniform Low-Level Radioactive Waste Manifest (Manifest Index and Regional Compact Tabulation)]. NRC Forms 540 and 540A must be completed and must physically accompany the pertinent low-level waste shipment. Upon agreement between shipper and consignee, NRC Forms 541 and 541A and 542 and 542A may be completed, transmitted, and stored in electronic media with the capability for producing legible, accurate, and complete records on the respective forms. Licensees are not required by NRC to comply with the manifesting requirements of this part when they ship:

(a) LLW for processing and expect its return (*i.e.*, for storage under their license) prior to disposal at a licensed land disposal facility;

(b) LLW that is being returned to the licensee who is the "waste generator" or "generator," as defined in this part; or

(c) Radioactively contaminated material to a "waste processor" that becomes the processor's "residual waste."

For guidance in completing these forms, refer to the instructions that accompany the forms. Copies of manifests required by this appendix may be legible carbon copies, photocopies, or computer printouts that reproduce the data in the format of the uniform manifest.

NRC Forms 540, 540A, 541, 541A, 542, and 542A, and the accompanying instructions, in hard copy, may be obtained from the Information and records Management Branch, Office of Information Resources Management, U.S. Nuclear Regulatory Commission, Washington, DC 20555, telephone (301) 415-7232.

This appendix includes information requirements of the Department of Transportation, as codified in 49 CFR part 172. Information on hazardous, medical, or other waste, required to meet Environmental Protection Agency regulations, as codified in 40 CFR parts 259, 261 or elsewhere, is not addressed in this section, and must be provided on the required EPA forms. However, the required EPA forms must accompany the Uniform Low-Level Radioactive Waste Manifest required by this chapter.

As used in this appendix, the following definitions apply:

Chelating agent has the same meaning as that given in § 61.2 of this chapter.

Chemical description means a description of the principal chemical characteristics of a low-lever radioactive waste.

Computer-readable medium means that the regulatory agency's computer can transfer the information from the medium into its memory.

Consignee means the designated receiver of the shipment of low-level radioactive waste.

Decontamination facility means a facility operating under a Commission or Agreement State license whose principal purpose is decontamination of equipment or materials to accomplish recycle, reuse, or other waste management objectives, and, for purposes of this, is not considered to be a consignee for LLW shipments.

Disposal container means a container principally used to confine low-level radioactive waste during disposal operations at a land disposal facility (also see "high integrity container"). Note that for some shipments, the disposal container may be the transport package.

EPA identification number means the number received by a transporter following application to the Administrator of EPA as required by 40 CFR part 263.

Generator means a licensee operating under a Commission or Agreement State license who (1) is a waste generator as defined in this part, or (2) is the licensee to whom waste can be attributed within the context of the Low-Level Radioactive Waste Policy Amendments Act of 1985 (*e.g.*, waste generated as a result of decontamination or recycle activities).

High integrity container (HIC) means a container commonly designed to meet the structural stability requirements of § 61.56 of this chapter, and to meet Department of Transportation requirements for a Type A package.

Land disposal facility has the same meaning as that given in § 61.2 of this chapter.

NRC Forms 540, 540A, 541, 541A, 542, and 542A are official NRC Forms referenced in this appendix. Licensees need not use originals of these NRC Forms as long as any substitute forms are equivalent to the original documentation in respect to content, clarity, size, and location of information. Upon agreement between the shipper and consignee, NRC Forms 541 (and 541A) and NRC Forms 542 (and 542A) may be completed, transmitted, and stored in electronic media. The electronic media must have the capability for producing legible, accurate, and complete records in the format of the uniform manifest.

Package means the assembly of components necessary to ensure compliance with the packaging requirements of DOT regulations, together with its radioactive contents, as presented for transport.

Physical description means the items called for on NRC Form 541 to describe a low-level radioactive waste.

Residual waste means low-level radioactive waste resulting from processing or decontamination activities that cannot be easily separated into distinct batches attributable to specific waste generators. This waste is attributable to the processor of decontamination facility, as applicable.

Shipper means the licensed entity (*i.e.*, the waste generator, waste collector, or waste processor) who offers low-level radioactive waste for transportation, typically consigning this type of waste to a licensed waste collector, waste processor, or land disposal facility operator.

Shipping paper means NRC Form 540 and, if required, NRC Form 540A which includes the information required by DOT in 49 CFR part 172.

Source material has the same meaning as that given § 40.4 of this chapter.

Special nuclear material has the same meaning as that given § 70.4 of this chapter.

Uniform Low-Level Radioactive Waste Manifest or *uniform manifest* means the combination of NRC Forms 540, 541, and, if necessary, 542, and their respective continuation sheets as needed, or equivalent.

Waste collector means an entity, operating under a Commission or Agreement State license, whose principal purpose is to collect and consolidate waste generated by others, and to transfer this waste, without processing or repackaging the collected waste, to another license waste collector, licensed waste processor, or licensed land disposal facility.

Waste description means the physical, chemical and radiological description of a low-level radioactive waste as called for on NRC Form 541.

Waste generator means an entity, operating under a Commission or Agreement State license, who (1) possesses any material or component that contains radioactivity or is radioactively contaminated for which the licensee foresees no further use, and (2) transfers this material or component to a licensed land disposal facility or to a licensed waste collector or processor for handling or treatment prior to disposal. A licensee performing processing or decontamination services may be a "waste generator" if the transfer of low-level radioactive waste from its facility is defined as "residual waste."

Waste processor means an entity, operating under a Commission or Agreement State license, whose principal purpose is to process, repackage, or otherwise treat low-level radioactive material or waste generated by others prior to eventual transfer of waste to a licensed low-level radioactive waste land disposal facility.

Waste type means a waste within a disposal container having a unique physical description (*i.e.*, a specific waste descriptor code or description; or a waste sorbed on or solidified in a specifically defined media).

Information Requirements

A. General Information

The shipper of the radioactive waste, shall provide the following information on the uniform manifest:

1. The name, facility address, and telephone number of the licensee shipping the waste;

2. An explicit declaration indicating whether the shipper is acting as a waste generator, collector, processor, or a combination of these identifiers for purposes of the manifested shipment; and

3. The name, address, and telephone number, or the name and EPA identification number for the carrier transporting the waste.

B. Shipment Information

The shipper of the radioactive waste shall provide the following information regarding the waste shipment on the uniform manifest:

1. The date of the waste shipment;

2. The total number of packages/disposal containers;

3. The total disposal volume and disposal weight in the shipment;

4. The total radionuclide activity in the shipment;

5. The activity of each of the radionuclides H-3, C-14, Tc-99, and I-129 contained in the shipment; and

6. The total masses of U-233, U-235, and plutonium in special nuclear material, and the total mass of uranium and thorium in source material.

C. Disposal Container and Waste Information

The shipper of the radioactive waste shall provide the following information on the uniform manifest regarding the waste and each disposal container of waste in the shipment:

1. An alphabetic or numeric identification that uniquely identifies each disposal container in the shipment;

2. A physical description of the disposal container, including the manufacturer and model of high integrity container;

3. The volume displaced by the disposal container;

4. The gross weight of the disposal container, including the waste;

5. For waste consigned to a disposal facility, the maximum radiation level at the surface of each disposal container;

6. A physical and chemical description of the waste;

7. The total weight percentage of chelating agent for any waste containing more than 0.1% chelating agent by weight, plus the identity of the principal chelating agent;

8. The approximate volume of waste within a container;

9. The sorbing or solidification media, if any, and the identity of the solidification media vendor and brand name;

10. The identities and activities of individual radionuclides contained in each container, the masses of U-233, U-235, and plutonium in special nuclear material, and the masses of uranium and thorium in source material. For discrete waste types (*i.e.*, activated materials, contaminated equipment, mechanical filters, sealed source/devices, and wastes in solidification/stabilization media), the identities and activities of individual radionuclides associated with or contained on these waste types within a disposal container shall be reported;

11. The total radioactivity within each container; and

12. For wastes consigned to a disposal facility, the classification of the waste pursuant to § 61.55 of this chapter. Waste not meeting the structural stability requirements of § 61.56(b) of this chapter must be identified.

D. Uncontainerized Waste Information

The shipper of radioactive waste shall provide the following information on the uniform manifest regarding a waste shipment delivered without a disposal container:

1. The approximate volume and weight of the waste;

2. A physical and chemical description of the waste;

3. The total weight percentage of chelating agent if the chelating agent exceeds 0.1% by weight, plus the identity of the principal chelating agent;

4. For waste consigned to a disposal facility, the classification of the waste pursuant to § 61.55 of this chapter. Waste not meeting the structural stability requirements of § 61.56(b) of this chapter must be identified;

5. The identities and activities of individual radionuclides contained in the waste, the masses of U-233, U-235, and plutonium in special nuclear material, and the masses of uranium and thorium in source material; and

6. For wastes consigned to a disposal facility, the maximum radiation levels at the surface of the waste.

E. Multi-Generator Disposal Container Information

This section applies to disposal containers enclosing mixtures of waste originating from different generators. [Note: The origin of the LLW resulting from a processor's activities may attributable to one or more "generators" (including "waste generators") as defined in this part.] It also applies to mixtures of wastes shipped in an uncontainerized form, for which portions of the mixture within the shipment originate from different generators.

1. For homogeneous mixtures of waste, such as incinerator ash, provide the waste description applicable to the mixture and the volume of the waste attributed to each generator.

2. For heterogeneous mixtures of waste, such as the combined products from a large compactor, identify each generator contributing waste to the disposal container, and, for discrete waste types (*i.e.*, activated materials, contaminated equipment, mechanical filters, sealed source/devices, and wastes in solidification/stabilization media), the identities and activities of individual radionuclides contained on these waste types within the disposal container. For each generator, provide the following:

(a) The volume of waste within the disposal container;

(b) A physical and chemical description of the waste, including the solidification agent, if any;

(c) The total weight percentage of chelating agents for any disposal container containing more than 0.1% chelating agent by weight, plus the identity of the principal chelating agent;

(d) The sorbing or solidification media, if any, and the identity of the solidification media vendor and brand name if the media is claimed to meet stability requirements in 10 CFR 61.56(b); and

(e) Radionuclide identities and activities contained in the waste, the masses of U-233, U-235, and plutonium in special nuclear material, and the masses of uranium and thorium in source material if contained in the waste.

II. Certification

An authorized representative of the waste generator, processor, or collector shall certify by signing and dating the shipment manifest that the transported materials are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation and the Commission. A collector in signing the certification is certifying that nothing has been done to the collected waste which would invalidate the waste generator's certification.

III. Control and Tracking

A. Any licensee who transfers radioactive waste to a land disposal facility or a licensed waste collector shall comply with the requirements in paragraphs A.1 through 9 of this section. Any licensee who transfers waste to a licensed waste processor for waste treatment or repackaging shall comply with the requirements of paragraphs A.4 through 9 of this section. A licensee shall:

1. Prepare all wastes so that the waste is classified according to § 61.55 and meets the waste characteristics requirements in § 61.56 of this chapter;

2. Label each disposal container (or transport package if potential radiation hazards preclude labeling of the individual disposal container) of waste to identify whether it is Class A waste, Class B waste, Class C waste, or greater than Class C waste, in accordance with § 61.55 of this chapter;

3. Conduct a quality assurance program to assure compliance with §§ 61.55 and 61.56 of this chapter (the program must include management evaluation of audits);

4. Prepare the NRC Uniform Low-Level Radioactive Waste Manifest as required by this appendix;

5. Forward a copy or electronically transfer the Uniform Low-Level Radioactive Waste Manifest to the intended consignee so that either (i) receipt of the manifest precedes the LLW shipment or (ii) the manifests delivered to the consignee with the waste at the time the waste is transferred to the consignee. Using both (i) and (ii) is also acceptable;

6. Include NRC Form 540 (and NRC Form 540A, if required) with the shipment regardless of the option chosen in paragraph A.5 of this section;

7. Receive acknowledgment of the receipt of the shipment in the form of a signed copy of NRC Form 540;

8. Retain a copy of or electronically store the Uniform Low-Level Radioactive Waste Manifest and documentation of acknowledgment of receipt as the record of transfer of licensed material as required by 10 CFR Parts 30, 40, and 70 of this chapter; and

9. For any shipments or any part of a shipment for which acknowledgment of receipt has not been received within the times set forth in this appendix, conduct an investigation in accordance with paragraph E of this appendix.

B. Any waste collector licensee who handles only prepackaged waste shall:

1. Acknowledge receipt of the waste from the shipper within one week of receipt by returning a signed copy of NRC Form 540;

2. Prepare a new manifest to reflect consolidated shipments that meet the requirements of this appendix. The waste collector shall ensure that, for each container of waste in the shipment, the manifest identifies the generator of that container of waste;

3. Forward a copy or electronically transfer the Uniform Low-Level Radioactive Waste Manifest to the intended consignee so that either: (i) Receipt of the manifest precedes the LLW shipment or (ii) the manifest is delivered to the consignee with the waste at the time the waste is transferred to the consignee. Using both (i) and (ii) is also acceptable;

4. Include NRC Form 540 (and NRC Form 540A, if required) with the shipment regardless of the option chosen in paragraph B.3 of this section;

5. Receive acknowledgment of the receipt of the shipment in the form of a signed copy of NRC Form 540;

6. Retain a copy of or electronically store the Uniform Low-Level Radioactive Waste Manifest and documentation of acknowledgment of receipt as the record of transfer of licensed material as required by 10 CFR parts 30, 40, and 70 of this chapter;

7. For any shipments or any part of a shipment for which acknowledgment of receipt has not been received, with the times set forth in this appendix, conduct an investigation in accordance with paragraph E of this appendix; and

8. Notify the shipper and the Administrator of the nearest Commission Regional Office listed in appendix D of this part when any shipment, or part of a shipment, has not arrived with 60 days after receipt of advance manifest, unless notified by the shipper that the shipment has been canceled.

C. Any licensed waste processor who treats or repackages waste shall:

1. Acknowledge receipt of the waste from the shipper within one week of receipt by returning a signed copy of NRC Form 540;

2. Prepare a new manifest that meets the requirements of this appendix. Preparation of the new manifest reflects that the processor is responsible for meeting these requirements. For each container of waste in the shipment, the manifest shall identify the waste generators, the preprocessed waste volume, and the other information as required in paragraph *I.E.* of this appendix;

3. Prepare all wastes so that the waste is classified according to § 61.55 of this chapter and meets the waste characteristics requirements in § 61.56 of this chapter;

4. Label each package of waste to identify whether it is Class A waste, Class B waste or Class C waste, in accordance with §§ 61.55 and 61.57 of this chapter ;

5. Conduct a quality assurance program to assure compliance with §§ 61.55 and 61.56 of this chapter (the program shall include management evaluation of audits);

6. Forward a copy or electronically transfer the Uniform Low-Level Radioactive Waste Manifest to the intended consignee so that either: (i) Receipt of the manifest precedes the LLW shipment or (ii) the manifest is delivered to the consignee with the waste at the time the waste is transferred to the consignee. Using both (i) and (ii) is also acceptable;

7. Include NRC Form 540 (and NRC Form 540A, if required) with the shipment regardless of the option chosen in paragraph C.6 of this section;

8. Receive acknowledgment of the receipt of the shipment in the form of a signed copy of NRC Form 540;

9. Retain a copy of or electronically store the Uniform Low-Level Radioactive Waste Manifest and documentation of acknowledgment of receipt as the record of transfer of licensed material as required by 10 CFR parts 30, 40, and 70 of this chapter;

10. For any shipment or any part of a shipment for which acknowledgment of receipt has not been received within the times set forth in this appendix, conduct an investigation in accordance with paragraph E of this appendix; and

11. Notify the shipper and the Administrator of the nearest Commission Regional Office listed in appendix D of this part when any shipment, or part of a shipment, has not arrived within 60 days after receipt of an advance manifest, unless notified by the shipper that the shipment has been canceled.

D. The land disposal facility operator shall:

1. Acknowledge receipt of the waste within one week of receipt by returning, as a minimum, a signed copy of NRC Form 540 to the shipper. The shipper to be notified is the licensee who last possessed the waste and transferred the waste to the operator. If any discrepancy exists between materials listed on the Uniform Low-Level Radioactive Waste Manifest and materials received, copies or electronic transfer of affected forms must be returned indicating the discrepancy;

2. Maintain copies of all completed manifests and electronically store the information required by 10 CFR 61.80(l) until the Commission terminates the license; and

3. Notify the shipper and the Administrator of the nearest Commission Regional Office listed in appendix D of this part when any shipment, or part of a shipment, has not arrived within 60 days after receipt of an advance manifest, unless notified by the shipper that the shipment has been canceled.

E. Any shipment or part of a shipment for which acknowledgment is not received with the times set forth in this section must:

1. Be investigated by the shipper if the shipper has not received notification or receipt within 20 days after transfer; and

2. Be traced and reported. The investigation shall include tracing the shipment and filing a report with the nearest Commission Regional Office listed in appendix D to this part. Each licensee who conducts a trace investigation shall file a written report with the appropriate NRC Regional Office within 2 weeks of completion of the investigation.